A GILLETTE PUBLICATION

WATER WORKS & SEWERAGE

December, 1936 — Editor — Volume 83. No. 12

DESIGN · CONSTRUCTION · COLLECTION
TREATMENT · DISTRIBUTION · DISPOSAL

CAST IRON PIPE is the preferred material today for permanent installations for reasons which have held good for more than two centuries—the strength and corrosion-resistance of the metal. We have improved the metal structure by our Super-de Lavaud Process of centrifugal casting in a metal mold *without chill.* We have developed linings, coatings and alloys for exceptional requirements, such as super-corrosive soils, waters and industrial processes. But with all that science and invention have contributed to the manufacture of U. S. Pipe, the two principal advantages of Cast Iron Pipe today are essentially native to the metal—great compressive strength and high resistance to corrosion.

U.S. cast iron PIPE

Cast iron and alloy cast iron pipe centrifugally or pit cast—for water works, gas, sewerage and drainage service as well as industrial uses involving corrosives.

U. S. PIPE & FOUNDRY CO.
BURLINGTON, NEW JERSEY
Foundries and Sales Offices throughout the U. S.

For Unloading, Conveying, Elevating and Reclaiming from Storage

The AIRVEYOR

The Airveyor Conveying System offers a maximum of economy and convenience in the handling of alum, bauxite, borax, lime, ferric sulphate, Fuller's earth, soda ash, and many other fine, crushed, and granular materials.

You can determine in advance how much such a system will save you. We know, from practical experience, what it will accomplish. Each installation is sold under a clean-cut guarantee on capacity and power requirements. Write our Engineering Department for information.

Write for this bulletin.

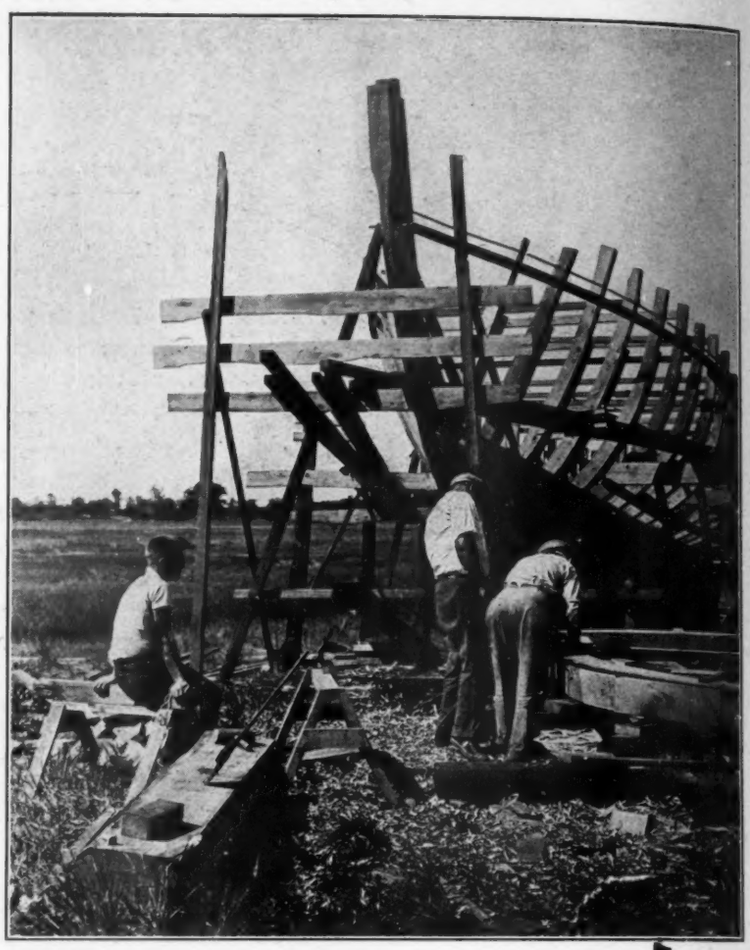
FULLER COMPANY
CATASAUQUA, PENNSYLVANIA
Chicago: 1118 Marquette Bldg.
San Francisco: 320-321 Chancery Bldg.

A-14

FULLER-KINYON, FLUXO, AND AIRVEYOR CONVEYING SYSTEMS · · · · ROTARY FEEDERS AND DISCHARGE GATES
ROTARY AIR COMPRESSORS AND VACUUM PUMPS · · AUTOMATIC BATCH WEIGHERS · · BIN SIGNALS

WATER WORKS AND SEWERAGE, December, 1936, Volume 83, Number 12. Published monthly at 400 West Madison Street, Chicago, Ill., by the Gillette Publishing Company. Per copy, 25c. Subscription rate, $2.00 per year; Canadian and Foreign, $3.00 per year. Copyright, 1936. Entered as Second Class Matter, June 2, 1931, at the Post Office at Chicago, Ill., under the Act of March 3, 1879.

LAYING *the* FOUNDATION *for the* NEW YEAR



For the past seven years we have endeavored to bring before the members of the water works fraternity the message of AQUA NUCHAR and through its application the furnishing of a water that is palatable. In that period close to one thousand plants have used this product—some daily, others only intermittently, and then when faced with the severest taste and odor conditions. We feel convinced there is a dose of AQUA NUCHAR that will eliminate these tastes even under the worst conditions but in so doing, on the surface, the cost seems exceedingly high and has frequently been the means of not considering its application.

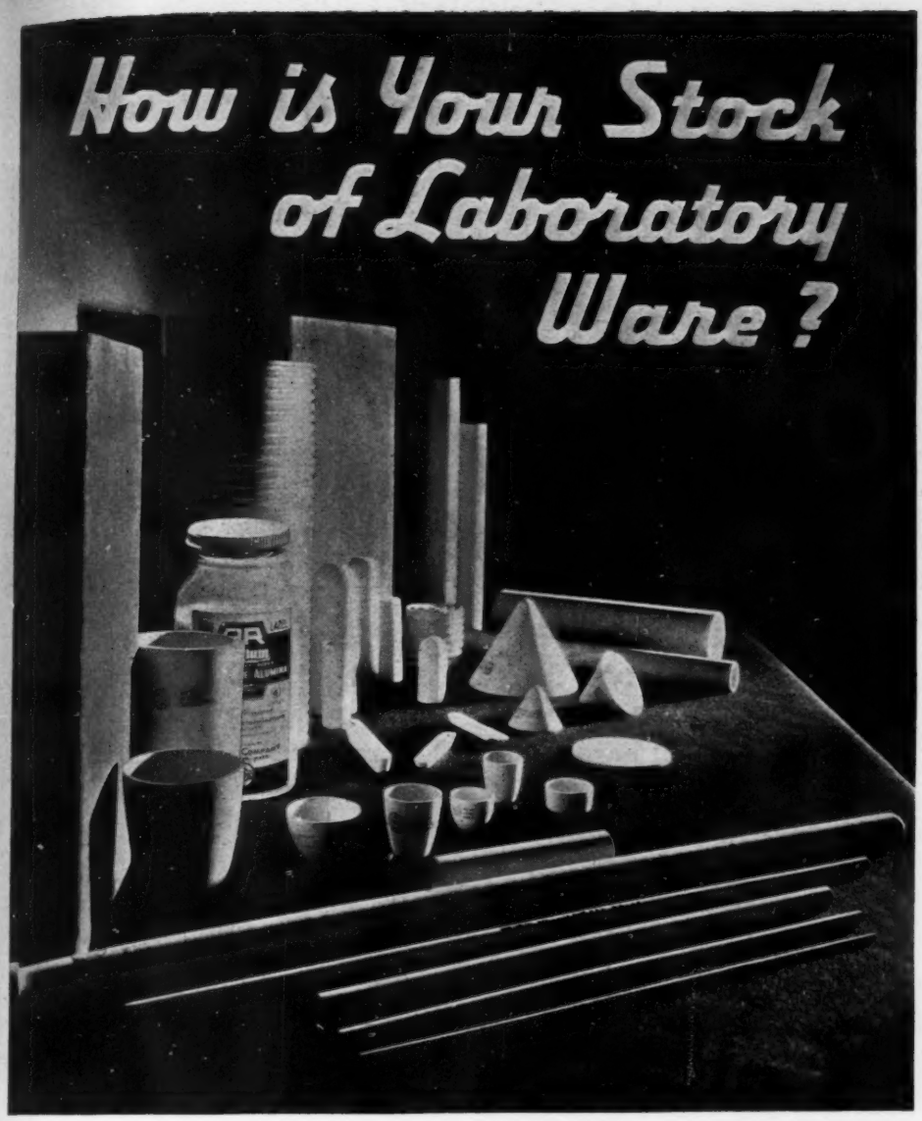
Our recommendation for the New Year is that consideration be given to the daily application of AQUA NUCHAR in small dosages, so that the Plant will be properly seeded and a gradual improvement in the water so that when severe tastes and odors are encountered in the raw water supply all that is necessary is to step up the dose to a point sufficiently large enough to eliminate these tastes. Actual experience has shown that this is economical and from a survey made of a number of plants—and using the per capita consumption of 100 gallons daily, it is estimated that the per capita cost of furnishing palatable drinking water using AQUA NUCHAR is slightly over 3c per year.

E. A. SIGWIRTH

During the past seven years, since AQUA NUCHAR has been introduced, we realized fully that it was during a period when many of the municipalities have been pressed for funds and all economical measures adopted to keep within the budget requirements. This period is gradually passing and more funds are available. We feel now is the time for the furnishing of a palatable water, since you are already furnishing one that is safe.

You have noted from the daily press the rising prices in practically all commodities and we know that you will be pleased to learn that AQUA NUCHAR will be available for the calendar year 1937 at prices no higher than have prevailed in the past.

INDUSTRIAL CHEMICAL SALES
Division West Virginia Pulp and Paper Co.
230 Park Avenue New York, N. Y.



For Ignition Incineration Filtration *in Municipal Laboratories*

ALUNDUM Laboratory Ware is characteristically strong, has high heat transfer properties and long life. Cleaning is a simple process of washing and igniting to constant weight.

There are tubes, cores and muffles for electric furnaces. Crucibles and dishes for igniting, incinerating and melting. Dishes, cones, discs, thimbles and crucibles for filtering. Combustion boats, pyrometer tubes and refractory cements.

A great variety of standard sizes and shapes are carried in stock for immediate shipment.

A catalog describing Norton Laboratory Ware will be sent upon request . . . . no obligation.

NORTON COMPANY, WORCESTER, MASS.

NORTON Refractory Laboratory Ware and RR Alundum are carried in stock by most laboratory supply houses and it is recommended that you purchase these materials through them. You will find laboratory supply dealers ready to assist you with your laboratory problems.

R-529

NORTON REFRACTORIES

Sewage Plants to be Proud of

■

GENEVA
ILLINOIS

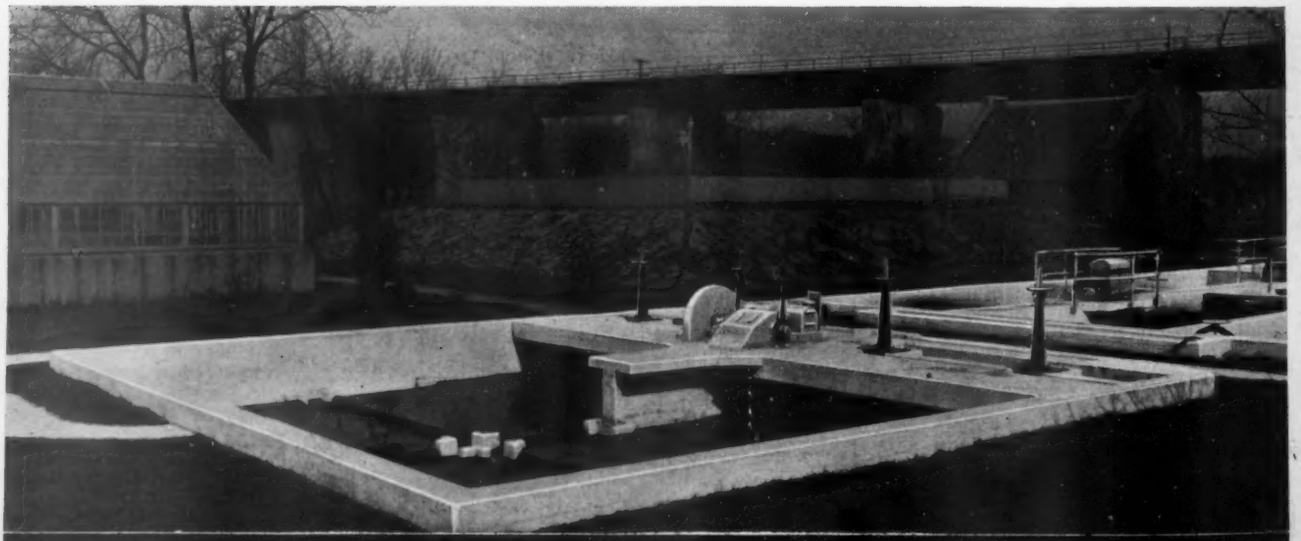
■

This modern, efficient plant is a study in beautification as well as in efficiency. The citizens of Geneva are proud to show it to out-of-town visitors. There are no sights or smells suggestive of sewage. And the effluent more than satisfies the State Board of Health. Wells Engineering Co. of Geneva were the Consulting Engineers.

We are proud of this plant, too; for Link-Belt Straightline collectors keep the two final tanks (lower illustration) continuously free of sludge.

The tanks did not have to be proportioned to fit the collectors, but were designed in proportions most effective for sedimentation, the Straightline collectors being made to fit any dimensions and to move the sludge to the hoppers by the shortest route, with a minimum of agitation. They are built for durable, efficient service; every feature of their design and construction being the result of years of experience — our own experience, not attempts to make "just as good" copies of others' designs.

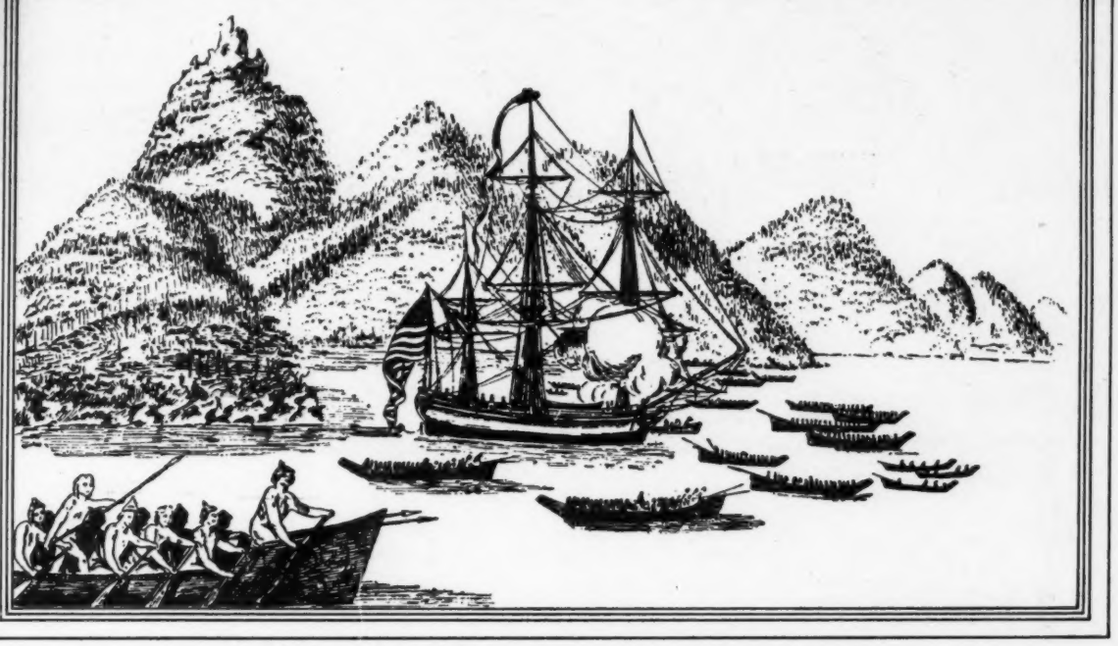
Send for catalog. Address Link-Belt Company, Philadelphia, Chicago, Los Angeles, Toronto, or any of our offices located in principal cities. 5050



LINK-BELT

SCREENS ▲ COLLECTORS ▲ AERATORS ▲ GRIT CHAMBERS ▲ DIFFUSERS

DISCOVERY



THE DISCOVERY OF THE COLUMBIA RIVER
AFTER AN OLD PRINT BY DAVIDSON

ON May 11, 1792, Captain Robert Gray of Boston, while on a voyage to open trade with the northwest coast of America, entered a great river which he named COLUMBIA, after his own vessel. Previously, the *Columbia* had been the first American ship to circumnavigate the globe.

Why don't you, too, discover COLUMBIA—the COLUMBIA ALKALIS which never vary, which set new standards of purity, which are backed with worry-free service? If you are not already specifying COLUMBIA for all soda products, may we suggest that the present, with its promise of prosperity for 1937, is a most opportune time to sign on.

SODA ASH · CAUSTIC SODA
SODIUM BICARBONATE
MODIFIED SODAS · CALCIUM CHLORIDE
LIQUID CHLORINE

Our technical staff will gladly cooperate on any unusual applications you may encounter.

THE COLUMBIA ALKALI CORPORATION

EXECUTIVE SALES OFFICES 30 ROCKEFELLER PLAZA • NEW YORK, N. Y.
Branch Sales Offices • BARBERTON, OHIO • 431-451 ST. CLAIR STREET, CHICAGO
CAREW TOWER, CINCINNATI • GRANT BLDG., PITTSBURGH • Plant at Barberton, Ohio

11 SELECT BURNING AS THE ONLY METHOD OF COMPLETE SEWAGE SLUDGE DISPOSAL

REALIZING the need for a satisfactory and economical solution of sewage sludge disposal problems, the municipalities shown on the map above have contracted for installation of Nichols Herreshoff Sewage Sludge Incinerators. They have followed the lead of the West Side Plant at Dearborn, Michigan, which has been benefiting for the past two years by this modern and economical method of sludge disposal. Numerous other cities and towns throughout the country have installation of incinerators under advisement. The introduction of this equipment has marked a significant phase in municipal sanitation.

The burning of sewage sludge as accomplished by this system destroys bacteria and organic matter, leaving only a fine, clean ash—in sharp contrast to the unsanitary sludge pile. Years of intensive research and development have made the dream of satisfactory disposal become a reality.

This organization is prepared to render an unusual service to engineers and public officials interested in solving municipal waste disposal problems.

NICHOLS HERRESHOFF SEWAGE SLUDGE INCINERATOR

NICHOLS ENGINEERING & RESEARCH CORP.
40 WALL STREET, NEW YORK

PACIFIC FOUNDRY CO., LTD.
3100 NINETEENTH STREET, SAN FRANCISCO

The MORSE *ALL-STEEL* FILTER PLANT

✓ Modern
✓ Flexible
✓ Economical
✓ Dependable
✓ Efficient

Facts you can check for yourself . . . . .

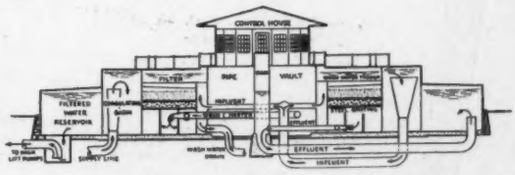
THE Morse *All-Steel* Filter Plant is no longer an experiment. First conceived as an economical design for capitalizing on the advantages of steel construction which have proved so desirable in large capacity water storage tanks, this development has gone much further. It offers an array of advanced features such as is seldom seen in a single development.

First and foremost, it is MODERN. It takes advantage of latest technical knowledge to give you a filter plant planned to stay up-to-date for years to come. It is FLEXIBLE—the design is readily adaptable to virtually any conceivable water condition and can be arranged for any combination of flow rates. It is ECONOMICAL—as much as 30 to 40% lower on first cost with all things being equal. It is DEPENDABLE—produces a consistently satisfactory effluent when competently operated, with possibilities of leakage and seepage eliminated.

For complete information on the Morse Filter Plant's EFFICIENCY, address our nearest office. Descriptive literature will be mailed promptly to interested readers.

At Burnt Mills, Md.

Pictured above is one of the Washington Suburban Sanitary District's *Morse Filter Plant* units at Burnt Mills, Md. Although only 100 ft. in diameter, this self-contained plant has a 5 m.g.d. capacity. Other designs are worked out for units ranging from 250,000 g.p.d. to 30,000,000 g.p.d. Below is a cross-section diagram of a typical unit.

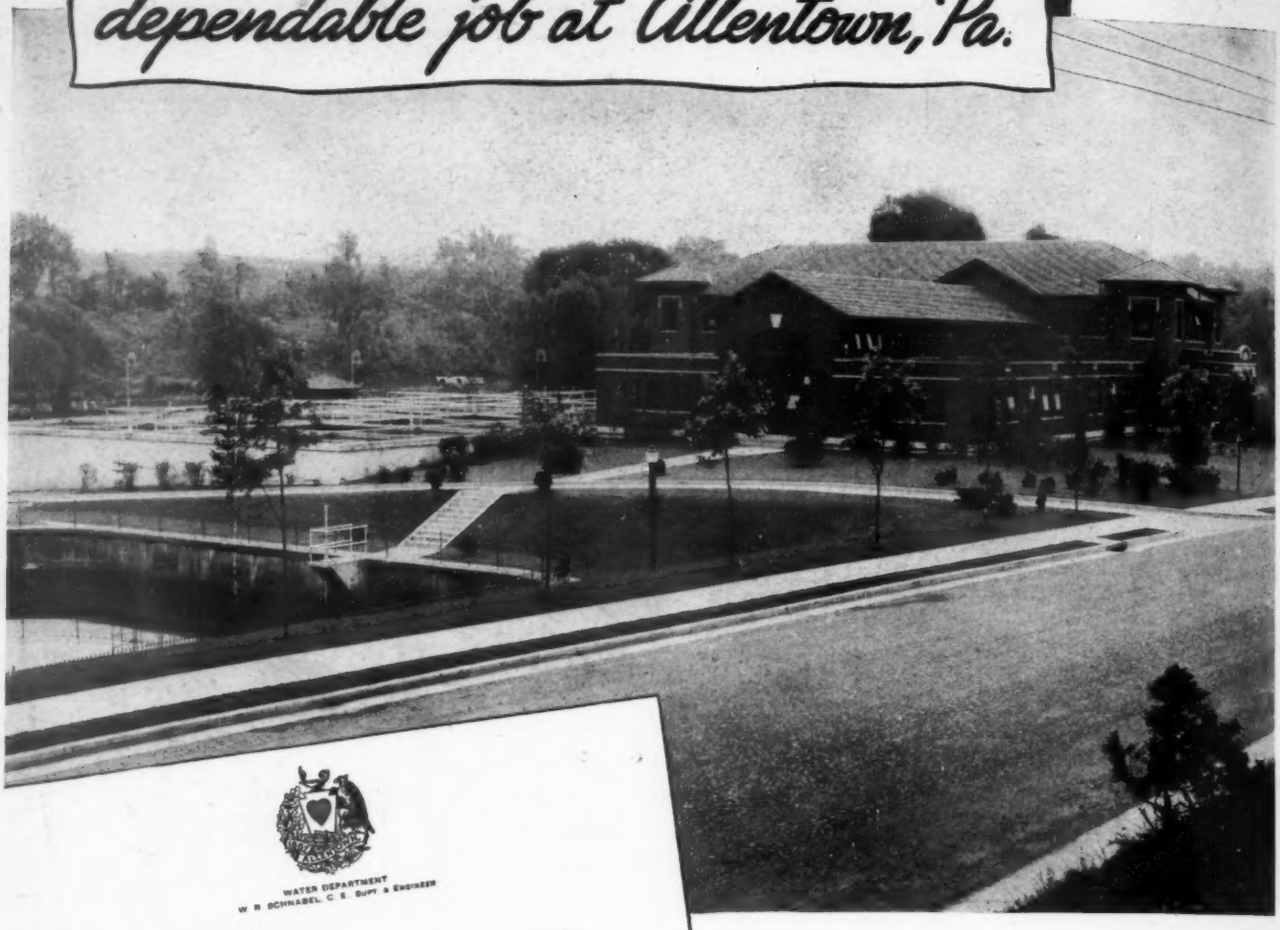


CHICAGO BRIDGE & IRON COMPANY

Chicago.....2198 Old Colony Bldg. Dallas.1479 Dallas Athletic Club Bldg. Houston.....2919 Main St. Boston.1548 Consolidated Gas Bldg.
New York.3390-165 Broadway Bldg. Birmingham...1586 North 50th St. Detroit.....1551 Lafayette Bldg. San Francisco....1083 Rialto Bldg.
Cleveland....2262 Rockefeller Bldg. Tulsa.....1646 Thompson Bldg. Philadelphia..1644-1700 Walnut St. Los Angeles...1455 Wm. Fox Bldg.

Fabricating plants in CHICAGO, BIRMINGHAM, and GREENVILLE, PA.

Mathieson Chemicals do a dependable job at Allentown, Pa.



WATER DEPARTMENT
W. R. SCHNABEL, C. E. Supt. & Engineer

September 26,1936

The Mathieson Alkali Works,Inc.,
60 East 42nd St.,
New York, N. Y.

Gentlemen:

We are pleased to reply to your recent inquiry regarding our use of and satisfaction with your products.

It may interest you to know that we have been users of your liquid chlorine for over twenty years. In this time we have been well served and have not been subjected to any inconvenience from dirty or sticky cylinder valves which we consider a distinct advantage.

We have also been users of HTH since its first introduction several years ago. We have found this product particularly useful in sterilizing our water mains up to 12 inches diameter.

In addition we have used HTH in our public swimming pools for sanitary purposes in foot baths and for cleaning up around the pools and as an emergency source of chlorine in the pools.

In the large,36 inch mains,we have found it economical to sterilize by adding liquid chlrine directly to the water from a cylinder transported to the job in a rig of our own make-up.

We might add in closing that we are small users of your light soda ash and have found this product as uniformly satisfactory in quality and from a service viewpoint as our other purcahses from you.

Yours very truly,
W. R. Schnabel
Supt. & Engineer

WRS:B

FROM the City of Allentown, Pa., comes this further evidence that water works men appreciate quality chemicals and dependable service—and that they select their sources of supply accordingly. Certainly Mr. Schnabel, whose letter is reproduced at the left, has shown his appreciation of these things in a very tangible way by using Mathieson Chlorine for over twenty years. Moreover, when he has needed other chemicals made by Mathieson, he has looked for—and found—the same high quality and prompt service that he had long come to associate with the name Mathieson.

The* MATHIESON ALKALI WORKS *(Inc.)
60 East 42nd Street **New York, N. Y.**

Soda Ash . . . Liquid Chlorine . . . Bicarbonate of Soda . . . HTH and HTH-15 . . . Caustic Soda . . . Bleaching Powder . . . Ammonia, Anhydrous and Aqua . . . PH-Plus (Fused Alkali) . . . Solid Carbon Dioxide

FIRST IN THE COUNTRY

IT WAS the friendly Indian guide who showed the pioneers the way to the richest and most productive lands in the great West. His advanced knowledge, gained by years of exploration, paved the way for the pioneer settlements. Just so, many years later, did the advanced knowledge of EBG engineers, gained by exploration in the fields where Liquid Chlorine could be used, pave the way for more productive methods in bleaching textiles, paper, and in better, more efficient methods of water and sewage sterilization. EBG, first to produce Liquid Chlorine in America, carries on this spirit of exploration by working steadily to discover new uses through which its customers may profit by its product.

ELECTRO BLEACHING GAS COMPANY
MAIN OFFICE: 60 E. 42nd ST., NEW YORK, N. Y.
PLANT: NIAGARA FALLS, N. Y.

EBG Liquid Chlorine

EFFICIENT WATER PURIFICATION REQUIRES

LIQUID CHLORINE

THAT IS EXCEEDINGLY

PURE

Liquid Chlorine produced by the Pennsylvania Salt Manufacturing Company is exceedingly pure. It is as dependable and uniform in quality as one may expect from a company having 86 years of experience in the production of chemicals for industry. For use in water purification and sewage treatment in any section of the country, quick delivery is assured by the convenient location of our plants. And, specialized technical service is immediately available without cost.

PERCHLORON · CHLORINE · AMMONIA · FERRIC CHLORIDE · ALUM

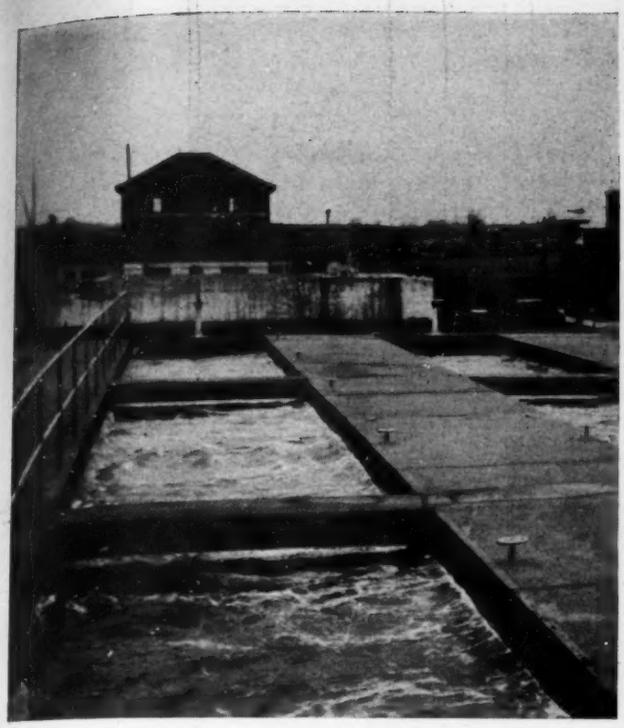
An advertisement of Pennsylvania Salt Manufacturing Company in the May Convention and Data issue of this magazine covers these and other products at greater length.

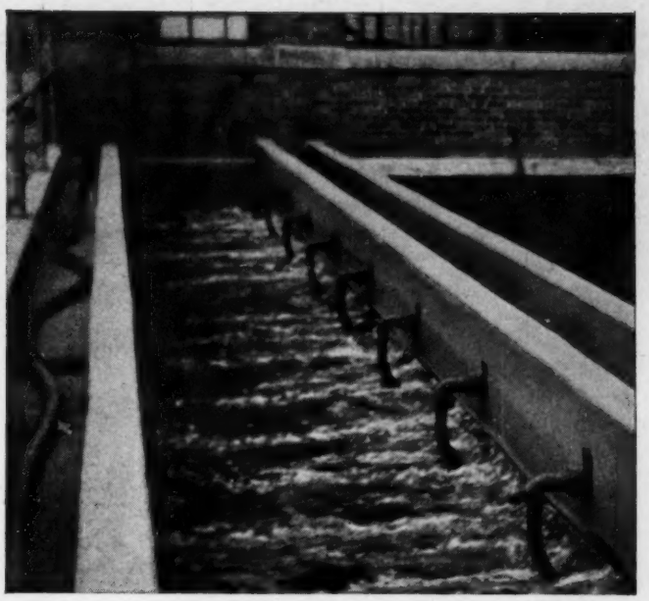
EST. 1850 TRADE MARK

PENNSYLVANIA SALT MANUFACTURING COMPANY

EXECUTIVE OFFICES, WIDENER BLDG., PHILADELPHIA, PA.

BRANCH SALES OFFICES: NEW YORK · CHICAGO · ST. LOUIS · PITTSBURGH · TACOMA · WYANDOTTE





PROVED BY PERFORMANCE

JUST as in the manufacture of high quality abrasive and refractory products, the research and resources of The Carborundum Company have combined to produce the efficient, proved-by-performance, Aloxite Brand Diffusers.

Three important factors influence the superior performance of these diffuser mediums:

Uniformity—Similarity of structure of all diffusers furnished for any installation and of individual portions of each diffuser is an inherent property. The resulting uniform air diffusion means much to efficient and long performance.

Economy—Low pressure loss (friction resistance) and small bubble diffusion have long been features of Aloxite Brand Diffusers—again the result of years of research work. Low pressure loss means lower operating pressure with decreased power costs. Small bubbles mean doing the same oxidation work with smaller quantities of air.

Accurate Testing—Aloxite Brand Diffusers receive accurate permeability rating regardless of weather because they are tested in an air conditioned laboratory. This is important to uniformity. *For real performance use*

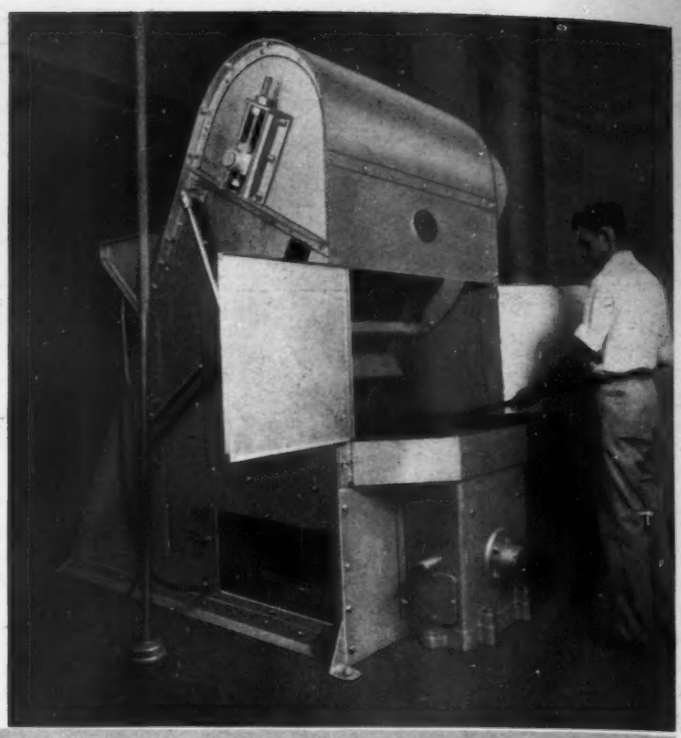
ALOXITE
REG. U. S. PAT. OFF.
BRAND
DIFFUSER MEDIUMS
PLATES AND TUBES

THE CARBORUNDUM COMPANY
REG. U. S. PAT. OFF.
NIAGARA FALLS, N. Y.

Sales Offices and Warehouses in New York, Chicago, Boston, Philadelphia, Cleveland, Detroit, Cincinnati, Pittsburgh, Grand Rapids

(Carborundum and Aloxite are registered trade-marks of The Carborundum Company.)

HOW TO HANDLE IT IF IT IS SCREENINGS



The Rex Triturator brings new advantages to shredding sewage screenings . . . .

● The Rex Triturator* now provides the ideal means of disposal for sewage screenings. Installed either as shown above for hand feeding or automatic control, it provides all the advantages of complete screenings disposal within the system. Its clean-cut shearing action of 350,000 blade cuts per minute completely disintegrates rags, papers and all forms of organic solids. The residue is returned to the sewage flow and becomes additional primary sludge.

The work is done with very low water and very low power consumption.

The Rex Triturator is a substantially built unit. It consists essentially of a toothed rotor revolving at high speed between two grates with the cutting teeth intermeshing the grate bars. Pivoting of the grates under heavy spring pressure provides for yielding of the grates under excessive loading, allowing the passage of tramp material without severe damage to the machine.

The Rex Triturator is new in design, appearance, operating principle and performance. Its capacity is large, operation simple, and power and maintenance cost low.

A new bulletin on this new addition to Rex Sanitation Equipment is now ready. Send today for your copy of The Rex Triturator Catalog.

CHAIN BELT COMPANY
1610 W. Bruce St., Milwaukee, Wis.

*Webster's Dictionary: Triturate — to comminute thoroughly.

REX **CHAIN BELT COMPANY** of MILWAUKEE
Sanitation Equipment

5 Gates of Everdur Metal

(STRENGTHENED COPPER)

High Strength...Long Life...Light Weight and Low Cost

FIVE of these easily *hand-operated* Everdur shut-off gates were installed in the screen room of the Rahway Valley Joint Meeting Sewage Treatment Works, Rahway, N. J. They have but *one-fifth* the weight of ribbed cast-iron gates with electric drive and control.

Such strong, light weight construction is frequently possible with Everdur Metal. This non-rust, high-strength alloy possesses corrosion resistance equal to copper. It is readily workable either hot or cold, and can be welded by any of the commonly used methods —making possible fabricating economies and important savings in weight.

Long life for these Rahway Valley gates is assured by the high corrosion resistance of Everdur, and its fine record in sewage treatment service since 1927.

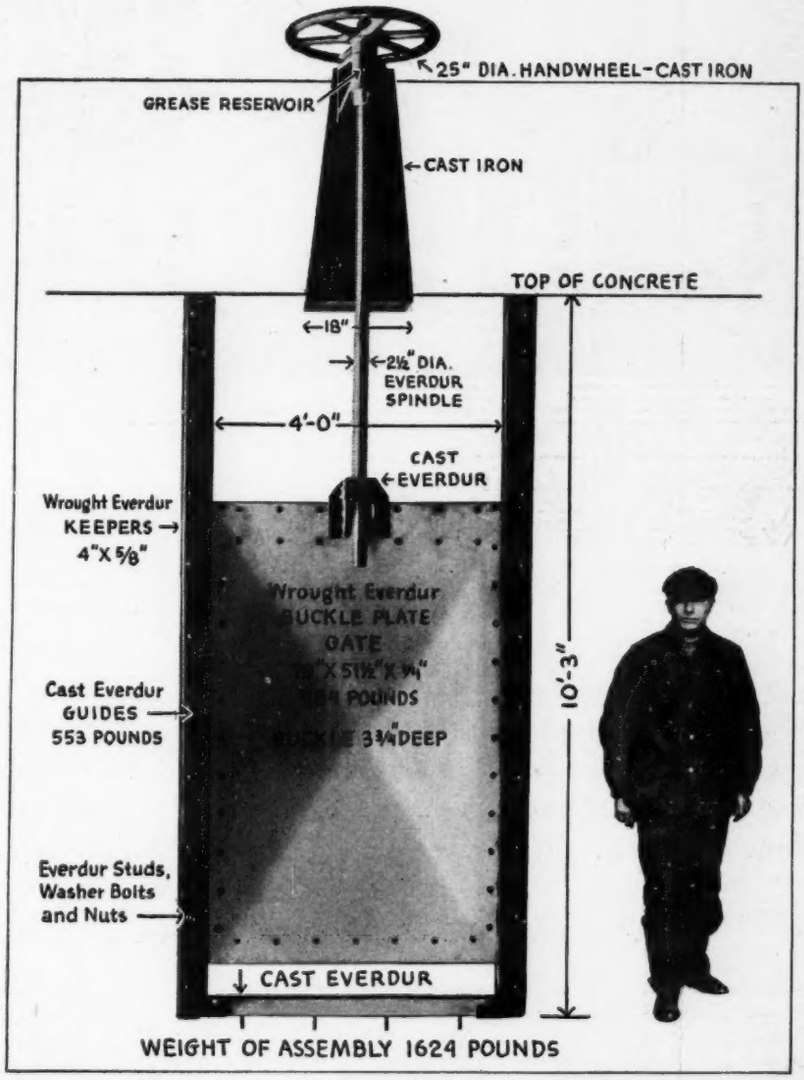
Everdur Metal is moderately priced and is available in all commercial shapes. Anaconda Publication E-11 gives the history of Everdur Metal in Sewage Treatment Equipment, Reservoir and Water Works Service. Write for it.

• • •

"EVERDUR" is a registered trade-mark identifying products of The American Brass Company made from alloys of copper, silicon and other elements.

EVERDUR IS BEING USED FOR

Coarse and Fine Screens, Swing Gates, Built-up Sluice Gates, Coarse Bar Rack Aprons, Effluent Weirs and Scum Weirs, Structural Scum Baffle Brackets, Troughs, Screen Hoppers, Orifices, Baskets, Anchors, Ladders, Float Gauge Chains, Valve Springs, Manhole Steps, Guides, Walkways, Bars and Plates, Bolts and Nuts.



One of the five shut-off gates ready for installation in Rahway Valley Sewage Treatment Works. Designed and built by Row Engineers, Inc., N. Y. Total weight of unit, including cast-iron stand, bearings and handwheel, is 1624 pounds.

ANACONDA
from mine to consumer

368:6

Anaconda Copper & Brass

THE AMERICAN BRASS COMPANY, General Offices: WATERBURY, CONNECTICUT

Offices and Agencies in Principal Cities . . . In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ont.

CORROSION
CAN BE LICKED BY ENGINEERING IT OUT

Corrosion of metal in the sewage disposal plant is a problem to which the engineer now has the answer. Modern practice starves corrosion out by specifying Alcoa Aluminum.

Nature made Aluminum resistant to the corrosive fluids and atmospheres of the sewage plant; research has made this advantage available for scores of applications ranging from miscellaneous hardware to stressed structural parts.

In many cases, as for example in a 168-foot rotary distributor, the lightness of Aluminum is also important in making upkeep and construction savings.

A note addressed to us will bring you either full information concerning the use of Alcoa Aluminum for up-to-date installation, or specific data covering the use of Aluminum to solve a particular problem. ALUMINUM COMPANY OF AMERICA, 2146 Gulf Building, Pittsburgh, Pa.

ALCOA ALUMINUM SHOULD BE USED FOR:

Screening Racks
Metal Roofing and Flashing
Sludge Collectors
Baffles and Scum Boards
Weir Plates
Diffuser Plate Holders
Air Ducts
Floating Covers
Scum Chamber Doors
Dosing Tank Equipment
Windows
Window Hardware
Doors
Door Hardware
Transom Frames
Electrical Conduit
Conduit Fittings
Light Fixtures
Bus Bar
Electrical Conductor Cable
Tubular Guard Railing
Tread Plates
Walkway Gratings
Trapdoors
Sidewalk Doors
Woven Fencing
Sheet Metal Louvers
Ventilation Hoods
Heating Ducts
Unit Heaters
Sluice Gates
Skylight Frames
Metal Trim
Office Furniture
Wheelbarrows
Small Tools

ALCOA

ALCOA ALUMINUM

WATER WORKS & SEWERAGE

E. S. GILLETTE, Publisher

L. H. ENSLOW, Editor

ARTICLES AND AUTHORS Scheduled for Future Issues

"Progress and Developments of 1936 in Water Supply" is to be reviewed in our January issue by Professor Lewis V. Carpenter, of New York University, who has been invited to repeat his excellent job in our January, 1936 issue, which brought so many favorable comments from readers.

"Progress and Developments of 1936 in Sewerage" is to appear in our February issue. The reviewer is no less than Chas. Gilman Hyde, Professor of Sanitary and Hydraulic Engineering at the University of California, and well known consultant in the water and sewage fields.

"A Novel Method of Scouring and Flushing Small Mains" will be described by Richard F. Brown, Plant Manager, California Water Service Co. Practical, effective, economical; the procedure involves the simplicity of "shooting" the mains with high velocity scouring injections of compressed air followed by flushing. (This article, promised our readers previously, is of primary interest preparatory to summer operation. It is therefore best to hold it for a more timely early Spring issue.—Ed.)

"Impressions of an English Sewerage Works Meeting" contributed by Dr. W. Rudolfs, at the request of WATER WORKS AND SEWERAGE, will interest many sewage workers and sanitarians in America. Dr. Rudolfs sets forth the processes of and proceedings transpiring during typical meetings of the British Institute of Sewage Purification, which is composed of works-managers, engineers and drainage-basin (rivers) authorities. As a keen observer, Dr. Rudolfs' impressions are enlightening, and may well prove suggestive to officials of American associations.

Consistent with our program of a continuing series "Kink" articles, during the year 1937, there will be many such of value. In this issue Carl Hechmer, well known operating engineer, contributes several useful "Kinks." Also, herein, is another "Kink" from E. E. Jacobson, operating engineer at Lexington, Ky. In a future issue, D. R. Taylor, Superintendent of the Roanoke (Va.) Water Company will reveal "Kinks" found useful by his company. "Kink" articles of interest to sewage-works operators and designing engineers, by operating and designing engineers or chemists, in the sewerage field, are also scheduled for 1937 issues.

"Practical Hydraulics" presented as a series of brief articles, in "every-day" language for the practical operator, will be continued in 1937 by P. S. Wilson, former general operating engineer for Community Water Service Co. and now Technical Secretary of A.W.W.A.

"Practical Electricity in the Plant," the first installment of which was so favorably received in our October issue, will be continued by Marsden C. Smith. In this issue his second article of the series appears and others, of value to water and sewage works operators and designers alike, will follow in 1937.

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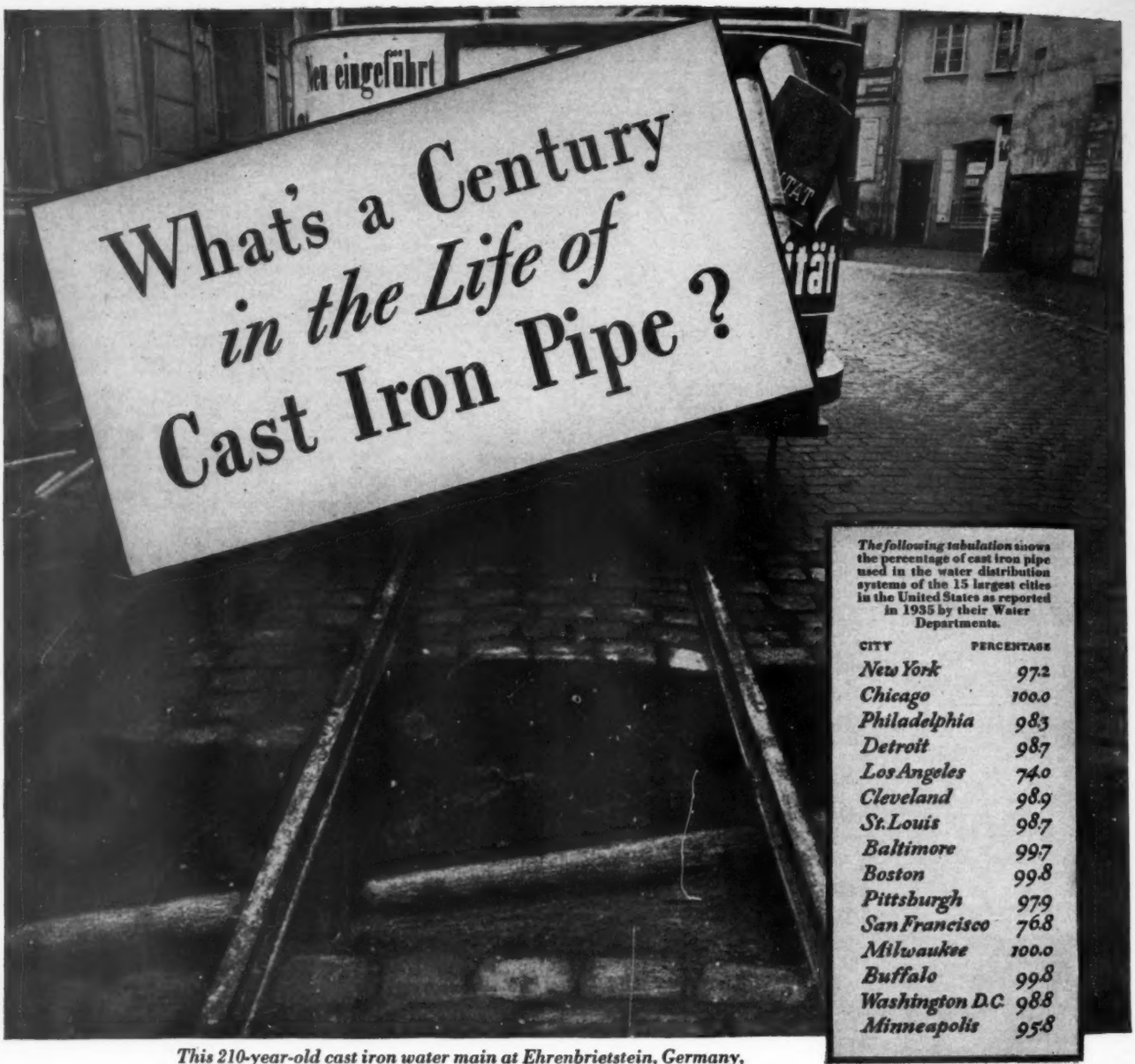

What's a Century
in the Life of
Cast Iron Pipe?
The following tabulation shows the percentage of cast iron pipe used in the water distribution systems of the 15 largest cities in the United States as reported in 1935 by their Water Departments.
CITY PERCENTAGE
New York 97.2
Chicago 100.0
Philadelphia 98.3
Detroit 98.7
Los Angeles 74.0
Cleveland 98.9
St. Louis 98.7
Baltimore 99.7
Boston 99.8
Pittsburgh 97.9
San Francisco 76.8
Milwaukee 100.0
Buffalo 99.8
Washington D.C. 98.8
Minneapolis 95.8

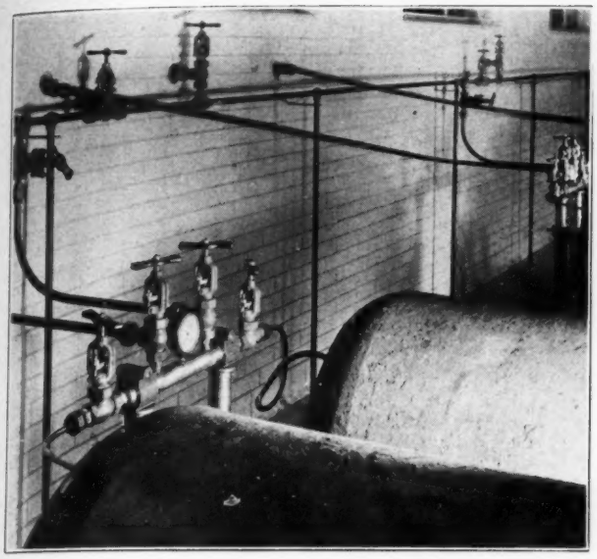
This 210-year-old cast iron water main at Ehrenbrietstein, Germany, is still in service and good condition. (Photograph by courtesy of Deutscher Gussrohr-Verband G. m. b. H., Cologne.)

IN OLDER cities abroad it is not uncommon to find cast iron water mains that have been rendering satisfactory service for from one to two centuries and longer. Many American cities have cast iron pipe in their distribution systems that has been serving for more than a century. Time has yet to reveal the full span of the useful life of cast iron pipe. That it serves longest and costs least per service year and least to maintain, are recorded facts and the reason for its almost exclusive use in the distribution systems of our 15 largest cities. Cast iron is the standard material for water mains. Its useful life is *more than a century* because of its effective resistance to rust. It is the one ferrous metal pipe for water and gas mains, and for sewer construction, that will not disintegrate from rust. Available in diameters from 1¼ to 84 inches. For further information, address The Cast Iron Pipe Research Association, Thos. F. Wolfe, Research Engineer, 1013 Peoples Gas Building, Chicago, Illinois.

CAST IRON PIPE

METHODS OF EVALUATING BIDS NOW IN USE BY ENGINEERS RATE THE USEFUL LIFE OF CAST IRON PIPE AT 100 YEARS

WATER WORKS AND SEWERAGE
A GILLETTE PUBLICATION
VOL. 83 DECEMBER, 1936 No. 12



A Near View of Container Valving and Connections. Note Ruggedness of Crane Valves, With Outside Yoke and Rising Stem, Which Can Be Packed Under Pressure. Another Feature, Threads Are Not Exposed to Chlorine.

CHICAGO'S MODERN CHLORINATING PLANT

Located at the New Cermak Pumping Station in the Center of Chicago

By A. E. GORMAN[1] and H. H. GERSTEIN[2]
Department of Public Works, City of Chicago

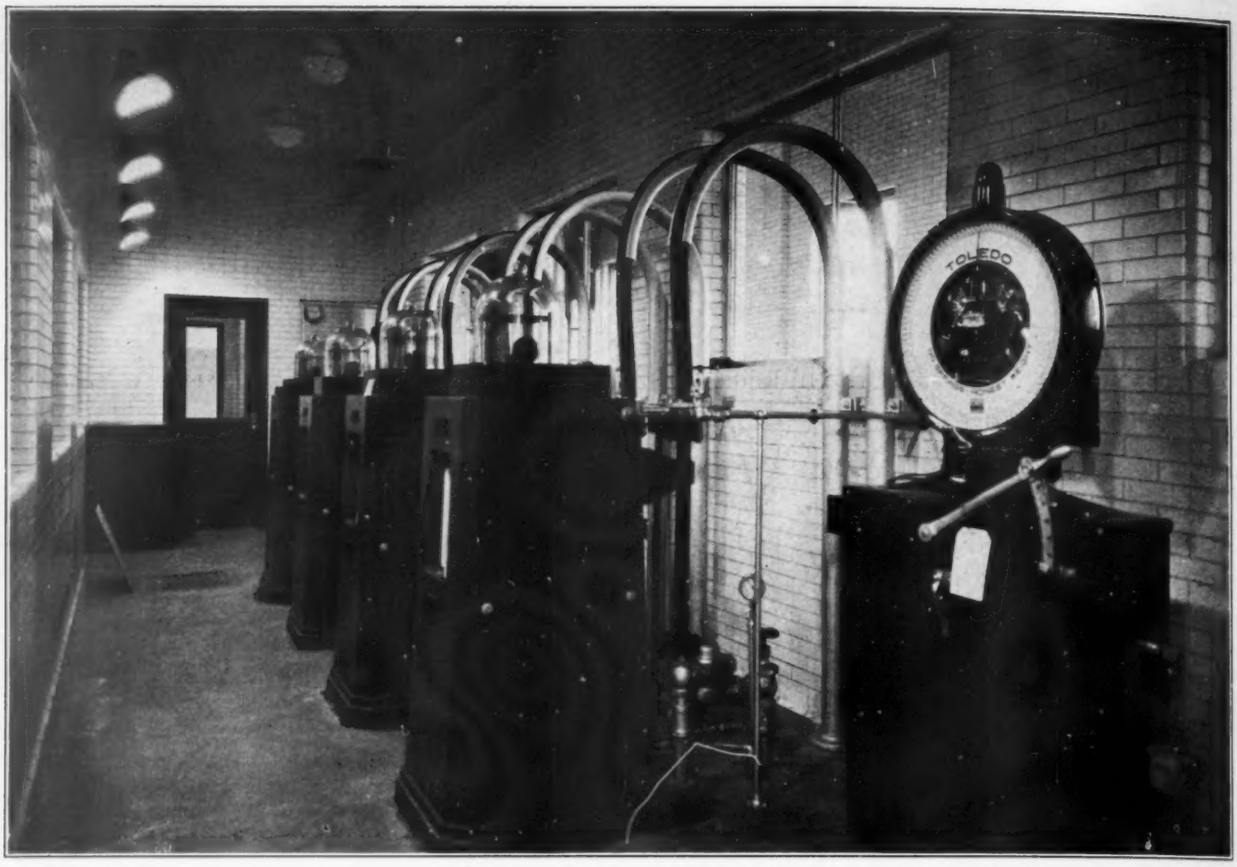
THE IMPORTANCE of the station, in serving one of the principal commercial and industrial areas of Chicago and its central location in a densely populated business district, exacted extraordinary care in planning and designing the chlorinating plant for the new 300 million gallon per day capacity Cermak Pumping Station in Chicago. It was essential to provide for efficiency of the highest order and economy of operation, as well as holding to a minimum every possible hazard due to the storage of and use of large quantities of chlorine. The use of large capacity chlorinators and chlorine in ton containers, instead of the 100 pound cylinders as practiced at other Chicago pumping stations, was decided on for two major reasons; one was due to limitations in space available for the chlorinating equipment; the other the desire for simplication of layout, operation and maintenance of the plant.

A reduction in the number of chlorinating units, as well as valves and connections for chlorine gas over those used at other stations, was the aim in order to provide greater safety of operation and at the same time permit a substantial saving to the city because of the lower cost of chlorine when purchased in one ton containers. Experience gained in operation of the plant, since it went into service in February of this year, has clearly shown that our expectations have been sustained. Therefore, similar layouts are to be used in the design of the new chlorinating plants for the Central Park and Springfield pumping stations, where substantial changes in pumping equipment have been made be-

In WATERWORKS & SEWERAGE *for October, 1936 appeared an article by Chicago's City Engineer, Loran D. Gayton, describing "Chicago's New Cermak Pumping Station," with especial emphasis on the many novel features which insure this important station against all conceivable operating failures.*

The present article, by Messrs. Gorman and Gerstein, is a companion article, dealing specifically with the chlorinating facilities of this station. Here are emphasized safety features and studied arrangements to assure continuity of chlorination, under all circumstances, and the minimum of hazard and expenses.—Editor.

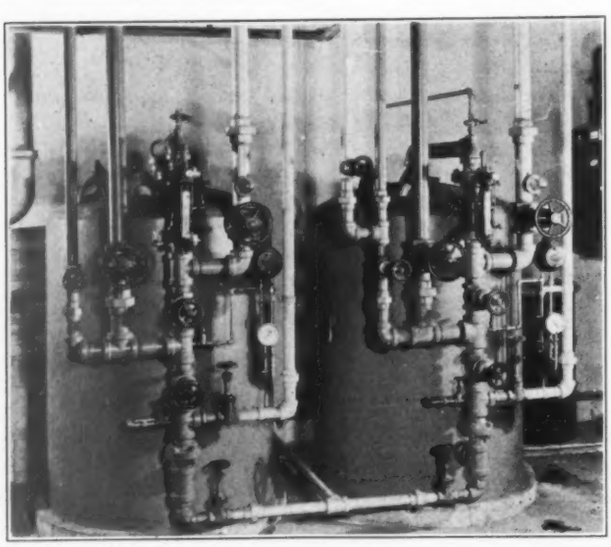
[1]Engineer of Water Purification; [2]Sanitary Engineer.



Chlorinator Room—Cermak Pumping Station—Chicago. Wallace and Tiernan Master-Vacuum 750 lb. day Capacity Chlorinators, and Dial of Toledo—6-ton Recording Scales—Behind the Wall Is the Scale and Ton Container Room.

cause of the additional supply from the new Chicago Avenue tunnel.

The chlorinating plant at Cermak Pumping Station consists of separate rooms for receiving and storage of chlorine; for chlorine containers in use (these are mounted on weighing scales and connected up to gas manifolds); for chlorinators and scale dials; and for the chlorine attendant's office. These rooms have fixed windows and each may be isolated from all other rooms in case of leakage of chlorine gas in any one of them. The auxiliary equipment, such as booster water pumps, water heater, filters and fans are located in the basement of the building. An innovation at this plant is the use of large plate glass windows in the wall between the main pumping station corridor and the chlorinating rooms to allow the visitors to observe the chlorinating equipment without interference with operation or being exposed to possible danger.



Pressure Filters Used to Insure Clean Water to Operate Chlorinators.

Container Handling and Storage

The ton chlorine containers are delivered by freight (multi-unit cars, of 15 containers each) to the municipal warehouse and transported by motor truck about 7 miles through the city to the pumping station. They are unloaded at the siding by means of a crane, 4 ton containers comprising a truck load. At the pumping station the containers are unloaded from the truck, one at a time, by means of a two-ton Shaw Box Electric Hoist operating on a monorail track, supported over the driveway by means of an A frame. They are then carried on the monorail into the receiving room where full and empty containers are stored. A switching arrangement on the monorail track allows the hoist to transfer the ton containers into the scale room where four Toledo 6-ton recording platform scales are located. Saddles are provided on each of the scales to hold two containers. Flexible copper leads from the containers are connected to a special double connection manifold. One connection is to a chlorine line directly connected to the particular chlorinator to be used for normal operation. The other line is connected to a single header, also connecting with the other three chlorine batteries and the four chlorinators. This second connection permits maximum flexibility of operation when and if needed. The dials of the four weighing scales are located in the

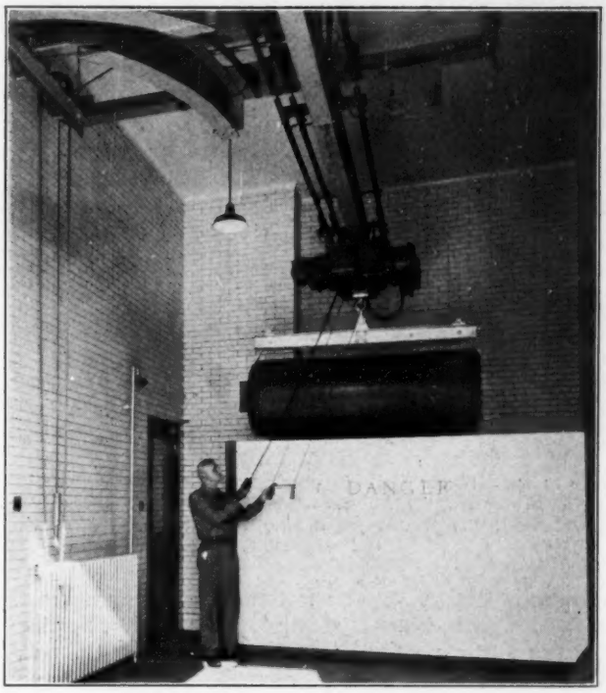
chlorinator room. Each scale is equipped with a recording apparatus which automatically prints the scale weight on a tape at intervals of 15 minutes and to an accuracy of less than one pound. The printed scale weights are considered valuable as a check on operating records regarding rate of application of chlorine to the water.

Piping and Valves

All of the piping for chlorine gas is of ½ inch *extra-heavy* black wrought-iron. The shutoff valves are of the outside yoke and packing type, manufactured by Crane Company.

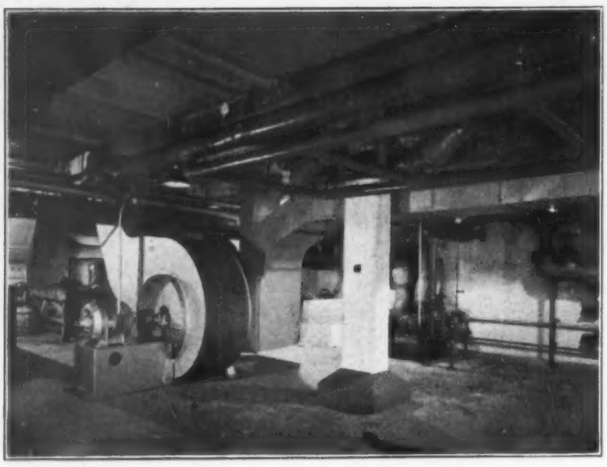
Chlorinators

The chlorinating equipment consists of four 750 pound per day capacity Wallace and Tiernan Master-Vacuum manual control, solution feed chlorinators. Each of these chlorinators is equipped with dual injectors and their maximum capacity can be increased to 1200 pounds per day by making slight changes in orifice sizes. With the addition of a third injector the capacity of each chlorinator may be increased to 2000 pounds per day. The chlorinators are specially designed to operate against a fluctuating head. (The water elevation in the chlorinating shaft may under various conditions of flow vary within wide limits.) The chlorinators are of a newly developed type, and before being purchased by the city, a demonstrator unit was placed on test under extreme as well as actual operating conditions for almost a year. During this period several



Emergency Caustic Solution Tank at End of Over-Head Monorail. In Case of Non-Repairable Leaking Valve or Fusible Plug the Container is Lowered Into Solution of Caustic More Than Ample to Absorb 2000 lbs. of Chlorine.

Ton-Container and Scale Room—Cermak Pumping Station, Chicago. Four Toledo 6-ton Recording Scales Carry Two Containers Each. Note the Manifold and Valving Arrangements—a Special Lead to Each Individual Chlorinator and a Long Manifold Common to All. Also Pictured is the Electric Hoist and Lifting Hook-beam.



One of the Exhaust Fans Located in the Basement. One Automatic Water Supply Booster Pump, Used in Emergency, and One Feed-Water Heater for Winter Use, Are Visible in Center Background.

changes in design were made to overcome operating difficulties. The chlorine solution from each chlorinator is carried to the point of application through two lines of 1½ inch rubber hose purchased under special specifications for chlorine service. The solution hose is carried in metal trays to the basement of the pumping station and thence through 4 inch pipe conduit across the street to the chlorinating shaft.

Operating Water Supply

The water supply to operate the chlorinators is obtained from three independent water mains in order to absolutely insure continuity of chlorination at all times. Special attention was given to the proper sizing of these pipes to provide ample water supply to the chlorinators under all conditions. All water piping to the chlorinators is in duplicate and the valve arrangements are such that an operator may shift from one water line to another with a minimum chance of error. As a further safety factor a booster pump of 120 gallons per minute capacity is provided to increase the water pressure to the chlorinators in case the line pressure should fall below 35 pounds per square inch.

The main water supply to the injectors is not heated, but the auxiliary supply which operates the diaphragm valves and other parts of the chlorinator is provided with a thermostatically controlled steam heater capable of maintaining a water temperature at least 55 deg. Fahrenheit at all times. This is to avoid operating difficulties due to water at freezing temperature in the winter. The auxiliary water supply is also filtered through sand and gravel pressure filters, in duplicate, in order to prevent the clogging of orifices in the chlorinator mechanism when the water is turbid. The filters are operated without coagulation and each is provided with a loss of head gauge equipped with an electric alarm to give warning when the loss of head through the filter has reached a pre-determined point, where operating difficulties might develop.

Safety

More special provisions for protection against the hazard of leaking chlorine gas have been incorporated in the design of this plant than for any of the other plants in the city. It was deemed prudent to do this because of the use of large chlorine containers in a congested industrial area not far from a thickly populated residential neighborhood. The various rooms in the chlorine quarters are provided with tight closing doors in order to be able to isolate any room in which a leak has occurred. Each room is provided with a forced air evacuation system which will permit better than one air change per minute. This system consists of a combination of fans. One set forces fresh air into the room at a point near the ceiling and the other set are suction fans, which pull the air out of the rooms from openings located at the lowest points of the room. In the scale room the take-offs are located in the scale pits and in the other rooms, grated openings are provided at various points in the floor. These fans are operated by push button controls located in the chlorine attendant's office. Under normal operating conditions the rooms are ventilated by a fan system which provides four complete air changes per hour. The fresh air is taken from the outside and heated to room temperature before being forced into the room.

A steel locker having compartments for individual gas masks for each employee is located in the operators' room. The compartments have glass fronts in order to have the masks visible for inspection at all times. As an additional protection in case serious gas leakage from a ton container should occur—one not controllable by other means—provision is made to absorb the leaking chlorine in a caustic soda solution. For this purpose, a welded steel tank, which is located in the receiving room, contains sufficient caustic soda solution to absorb more than a ton of chlorine. The monorail track is carried over the tank, thus providing a means for lowering a non-repairable leaking container into the caustic soda.

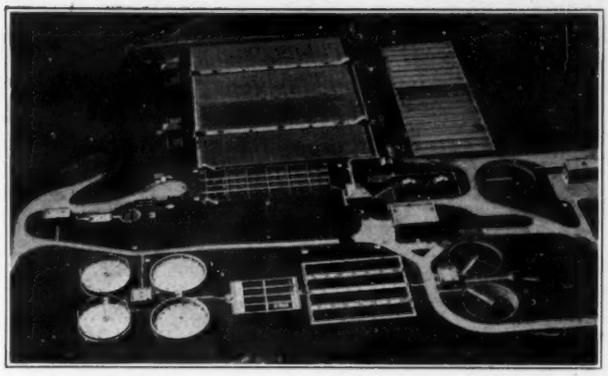
Operators' Facilities

In the chlorine operators' room are sampling taps connected to the discharge of each of the six pumps. There are also two sampling taps from the two sources of raw water supply in the tunnels serving the pumping station. The sampling taps from the pumps in operation are allowed to run continuously. Samples are taken from them for the hourly residual chlorine determinations. The raw water pumps are operated daily to permit collection of samples of the tunnel waters for routine bacterial and microscopic examination.

Due to the characteristic of the pumps which change pumpage rate with variations in head, it is planned to install a "Chronoflo," remote indicating and recording meter, which will totalize the flow of the six venturi meters and indicate the data in the chlorine attendant's office. With this totalized pumpage recorded continuously the operator can regulate the chlorine feed to follow more accurately the changes of pumpage.

Acknowledgment

Acknowledgment is made to Commissioner of Public Works Oscar E. Hewitt and Acting City Engineer Loran D. Gayton, under whose direction the plant was built. The detailed design of the plant was carried out under Engineer of Water Works Design O. B. Carlisle and the construction work by city labor under Engineer of Water Works Construction J. J. Versluis. Assistant Engineer A. G. Anderson was in local charge of construction. The operation of the plant is now in charge of Chief Operating Engineer Patrick Enright.



The Nine Springs Sewage Treatment Works of Madison, Wis. (Greeley & Hansen, Engineers.) An interesting "competition" of Sprinkling Filters vs. Activated Sludge. See digest of description by H. O. Lord, Chief Engr., appearing in this report.

CONVENTION OF THE CENTRAL STATES SEWAGE WORKS ASSOCIATION

High Rate Bio-Filtration the Featured Topic

IN INDIANAPOLIS on October 29th and 30th was held the Ninth Annual Convention of the Central States Sewage Works Association. Considering the fact that this association is the third largest in the Federation (239 members) and draws members from the states of Indiana, Illinois, Wisconsin and Minnesota, the registered attendance of 128 members and guests can but be considered below par.

In a territory as rich in potential members and meeting attendance, as that covered by the Central States Association, the sparse registrations at its meetings are seemingly indicative of the effect of non-central meeting places. Also, there is the inescapable conclusion that there is need for holding more than one meeting each year to effectively serve the four-state territory; or, else, the division of the association into two-state organizations holding centralized meetings annually.

The Secretary, Gus H. Radebaugh, reported a new membership gain of 45 for the past year and $799.54 bank balance, with only 11 members in arrears on dues.

The Annual Dinner, presided over by C. K. Calvert, in charge of local arrangements and technical program, was a decided success. The principal speaker, Dr. Thurman B. Rice, Professor of Health and Hygiene, Indiana School of Medical Research, presented many pertinent facts and much philosophy concerning the modes of 1936 and the meaning of mental-hygiene as the new science of Life. After his thought-provoking talk, the evening closed with a worthy floor-show consisting of Indianapolis talent. During the course of the evening, Mrs. Arthur B. Morrill, wife of Detroit's Sewerage Engineer, was prevailed upon to render repeatedly encored vocal selections.

Retiring President O. M. Leonard, Indianapolis.

President-Elect Prof. H. E. Babbitt, University Illinois.

Awards

The annual award to the author of the best paper delivered before the association during the year was presented to A. J. Beck, Chemist of the Chicago Sanitary District, for his paper—"Diffuser Plate Studies"—which is to be found in Sewage Works Journal. The prize consists of the interest derived from bonds held by the association for the purpose.

In the Gadget Competition, by vote of members the following awards were made by C. C. Larson, as Chairman of Committee on Awards:

1st Prize—A Sewage Sampler—by Geo. Martin, Green Bay, Wis.

2nd Prize—An Immersion Turbidimeter—by Don E. Bloodgood, Indianapolis. (For description see "WATER WORKS & SEWERAGE," Apr., 1933.)

3rd Prize—An Incubator for B.O.D. Tests—by W. D. Hatfield, Decatur, Ill.

Resolutions

Among the resolutions presented by Paul Hansen for the Resolutions Committee was one of especial significance in its relationship to the advancement of movements under way leading to operator licensing acts in the several states. The resolution directed attention to the desire for greater stress on the need for placing trained and qualified operators at sewage treatment works; and, the hazards of poor economies resulting from placing such plants under unqualified operators. It called on local and state authorities to take more definite action toward insuring appointment of qualified operators only and copies of the resolution were especially directed to Health Commissioners of the four states served by the association.

This important resolution further stressed the need for increasing the security of the qualified operator through "the insurance that such approved personnel be

The Secretary, Gus H. Radebaugh, Urbana, Ill.

Indiana State Sanitary Engineer D. A. Poole, Elected Vice President.

continued so long as service proved technically satisfactory."

Another resolution requests the Federation of Sewage Works Associations to take whatever action might seem proper to hasten the needed revision of the "Glossary of Terms" used in sewerage and treatment practice, produced jointly by A.S.C.E. and A.P.H.A. without revision since 1928.

To Chas. Brossman, Indianapolis Consulting Engineer and a charter member, was sent the sympathy and best wishes of the association for his unfortunate automobile accident.

New Officers

Officers named for the ensuing year are:

President—Prof. H. C. Babbitt, University of Illinois, Urbana, Ill.

1st Vice-Pres.—Dean, F. M. Dawson, University of Iowa, Iowa City, Ia.

2nd Vice-Pres.—Geo. J. Schroepfer, Sewerage Commission, Minneapolis, Minn.

3rd Vice-Pres.—D. A. Poole, State San. Engr., Indianapolis, Ind.

Secretary—Gus. H. Radebaugh, Sanitary District, Urbana, Ill.

Treasurer—C. K. Calvert, Indianapolis Water Co., Indianapolis, Ind.

To the Board of Control of the Federation of Sewage Works Associations were re-elected Jas. L. Ferebee, and W. W. DeBerard.

By vote, the Twin-Cities of Minnesota were selected as the 1937 Convention place.

Inspection Trips

During the meeting groups visited the extension work under way at the Indianapolis Treatment Works, which will practically double the plant capacity. On demonstration, was a new grit washing mechanism being developed by the Jeffrey Manufacturing Company under the direction of S. L. Tolman, formerly Engineer in Charge of Chicago's North Side plant and Charter Member of C.S.S.W.A. After the meeting a group visited two milk waste treatment plants—one employing the Halvorson method of high rate bio-filtration and another the Guggenheim method of bio-aeration aided by ferric iron coagulation and sludge return. Also, "America's most unique interesting activated sludge plant" at Richmond, Ind., involving supplementary "free" aeration, by utilization of the natural head available and gas engine power, was visited.

Walter A. Sperry, Aurora, Ill.

Dr. F. W. Mohlman, Chicago.

Technical Sessions

(Chairman, C. M. Leonard, Presiding)

"The New Treatment Works of Kokomo, Ind.," by RUSSELL B. MOORE, Cons. Engr., Indianapolis, Ind.

Mr. Moore briefly described the new plant under construction at Kokomo, Ind., involving rotary sprinkling filters, two-stage sludge digestion, mechanical denaturing and incineration of digested or fresh sludge cake with garbage. After investigation and taking bids, the Herreshoff type of rabble arm multiple hearth incinerator developed by Nichols Engineering Co. and first put to successful use at Dearborn, Mich., had been selected. Mr. Moore said he based his selection on performance records at Dearborn, and complimented Mark B. Owen on his pioneering undertaking there. He described

Jas. L. Ferebee, Chief, Milwaukee Sewage Comm. (Member Federation Board of Control); Cecil K. Calvert, Indianapolis Water Co. (Treas. and Chairman Comm. on Arrangements); Paul Hansen, Consulting Engr., Chicago (Chairman Resolutions Committee).

the 9½ ft. diameter 6-hearth incinerator in some detail, the two upper hearths merely serving as drying units with the revolving rabble arms supplying efficient mechanical stoking on the drying and lower four burning hearths. The manufacturers' guarantee at Dearborn had been 90 cents per wet ton of sludge cake for fuel (oil) as against 35 cents actually experienced. At Kokomo the guarantee of 80 cents was in excess of expectations. On this basis, however, sludge incineration with garbage was chosen after comparison with sand bed drying costs. The sludge was to be dewatered on an Oliver vacuum-filter unit located above the furnace. The dryness of cake (lime and ferric chloride conditioning) would be determined on the basis of net costs involving fuel oil vs. chemicals required for greater dryness of cake.

"Some Fundamental Factors Concerned in the Operation of Trickling Filters," by DR. H. O. HALVERSON, University of Minnesota, Minneapolis, Minn.

Dr. Halvorson after discussing the many theoretical and practical considerations of the trickling filter, reviewed some of his reasonings and the experimentation which led to the conclusions that a high rate of sewage application, with uniform and continuous distribution over the filter bed surface, was ideal for a combination effect producing economies of structures, of operation

and of efficiencies of the rugged sprinkling filter. After considerable experimentation with settled domestic sewages, at rates varying from 2 to 30 m.g./day/acre, the conclusions reached were that the optimum seemed to be in the neighborhood of 20 m.g.d./acre continuously applied. The results were found superior to a rate of 10 m.g.d., involving intermittent application. The high rates produced self cleansing bed action and almost continuous unloading, leaving but thin and efficient oxidizing films on the filter stone or other media. Likewise, nearly perfect fly breeding elimination because of constant wetting of breeding surfaces.

In discussing effects of variations in air and sewage temperatures, Dr. Halvorson said that natural bed ventilation was deficient when air and sewage temperatures came close together, and during such periods in summer forced draft had proven of value. In winter the natural draft was sufficient and the forced cold air draft had proved detrimental.

(The paper presented by Dr. Halvorson was essentially that which has already appeared in the September, 1936, issue of WATER WORKS AND SEWERAGE.—Ed.)

"A Year's Operation of a High Rate Trickling Filter," by DR. F. W. MOHLMAN, Director of Laboratories, Chicago Sanitary District, Chicago, Ill.

Dr. Mohlman's highly interesting paper revealed operating results and experiences with an experimental high-rate trickling filter (20 ft. diam. 8 ft. deep) operated continuously since September, 1935, under his supervision at Chicago. During the first five months 15 to 18 per cent of the filter effluent was recirculated by its return to the applied sewage. There had been no apparent benefits from effluent return, possibly explained by the relative weakness of the crude sewage (B.O.D. 82 to 130), and, thereafter (without recirculation), an average of 20 m.g.d./acre of settled sewage had been continuously applied (24 hours) every day. In the early stages the unit had stored up solids, raising the question—"Would it clog?" Relief was felt when it finally began to unload at approximately bi-monthly intervals, followed by unloading to some degree continuously. It did not pond and fly breeding was very limited, those present remaining mostly below the clean bed surface. Concerning the value of artificial aeration, little benefit had appeared with the weak sewage handled, even during August. The filter had gone through the coldest winter on record without troubles developing, but cleaning nozzles of the revolving distributor arms had been frequent. The sludge in the final tank ran 2 to 3 per cent solids, contained better than 4 per cent nitrogen and seemed well suited for dewatering on vacuum filters.

C. F. Classen, Chief Engineer, Ill. State Dept. Health.

L. F. Warrick, Chief Engr., Wisc. State Dept. Health.

Relative to results, the bed had removed on the average 3,763 lbs. (peak months 5,150 lbs.) of 5-day oxygen demand per acre per day equivalent to 470 lbs./acre/ft. as the real measure of work accomplished. The final effluent, after somewhat deficient settling (1 hr. period) ran 12 to 17 B.O.D. in summer and 28 B.O.D. during winter operation with peaks reaching 44 B.O.D. during unloading periods when considerable of the lightest suspended solids (36 p.p.m.) passed through the final tank. (The monthly averages appear in the accompanying table.—Ed.) Nitrite and nitrates in the final effluent had varied from February minimum of 1 p.p.m N. (B.O.D. = 44) to September maximum of 4.1 parts (B.O.D. = 12.3). During September, 1936, with 1.5 hr. period provided in final tank, the B.O.D. of effluent had averaged 12.3 and solids 16 parts; this, even though the rate boost to 26.6 m.g.d./acre was being applied.

Successful Gadgeteers

George Martin, Supt. Sewerage, Green Bay, Wis.; Dr. W. D. Hatfield, Supt. Treatment, Decatur, Ill.; Don E. Bloodgood, Supt. Treatment, Indianapolis.

OPERATION RESULTS FROM HIGH-RATE TRICKLING FILTER AT CHICAGO

(Mohlman)

R.S. = Raw Sewage F.E. = Filter Effluent
I.E. = Imhoff Effluent S.F.E. = Settled Filter Effluent

Month	5 day B.O.D. (P.P.M.)				Suspended Solids (P.P.M.)			
1935-36	R.S.	I.E.	F.E.	S.F.E.	R.S.	I.E.	F.E.	S.F.E.
*Sept. 11/30	82	36.2	18.5	14.8	120	40	24	20
*October	121	47.2	27.2	18.6	183	52	32	22
*November	97	44.5	61.6	27.7	120	43	87	28
*December	118	66.2	51.6	35.6	119	53	59	28
January	130	59.3	44.0	28.5	128	42	34	24
February	150	74.5	57.8	43.9	158	60	49	36
March	54	30.9	29.1	16.3	74	35	29	19
April	95	52.7	39.0	23.5	124	54	48	30
*May	96	49.3	58.2	27.2	142	56	127	44
*June	82	46.8	53.8	25.5	100	50	70	30
*July	63	34.7	40.7	17.2	89	35	48	23
August	79	28.1	18.5	13.3	102	38	36	23
Average	97	47.6	....	24.3	122	47	..	27
September	71	26.6	75	12.3	107	38	140	16

*Months during which artificial aeration employed.

Dr. Mohlman, by summary, stated that although the results had not come up to activated sludge perform-

Russell B. Moore, Consulting Engr., Indianapolis; A. J. Beck, Chemist, Chicago Sanitary District (Author of 1935 Prize Paper); Walter Peirce, Mgr. Water Dept., Racine, Wis. (Sees Sewage Treatment Coming His Way).

C. C. (Chief Chemist) Larson, Springfield, Ill.; Paul W. Richards, Asst. Supt. Wastes Disposal, Indianapolis; M. W. Tatlock, Supt. Treatment Works, Dayton, O. ("Tat" played "Put and Take" with W.P.A.—Who Won? Read this report.)

ance, when providing 2 hour aeration and .05 cu. ft. air/gal., they had surpassed, in reality, those expected from chemical precipitation because of the nitrate value in the biological effluent in summer. The filter at high rate had acted as a biological flocculator removing colloidal material similar to the chemical precipitation effects. Like the latter settling periods of 1.5 hours seemed necessary. The filter operations would be continued at the 26.6 m.g.d./acre rate for the purposes of further study. B.O.D. removals of 3,763 lbs. per day per acre for the high rate unit at Chicago, compared with 1,645 for the 6 ft. deep Decatur filters and only 850 lbs. at the Chicago normal rate experimental filter at Calumet.

In the discussion which followed the Halvórson and Mohlman papers, L. H. Enslow commented on a previously established truth, resulting from the New Jersey Department of Health surveys and studies—viz., that advantages from uniform distribution and short resting periods between dosages were evident. The results from the long-time, commonly considered overloaded shallow filters at Pontiac, Mich., the lack of freezing troubles and fly breeding, all indicated that the results from the high rate filtration demonstrations were in line. He considered the deficient final settling at Chicago of questionable fairness to the test and felt that a larger settling assisted by minor dosage of coagulent in the applied sewage, such as demonstrated at Atlanta, Ga.; or, the adaptation of a mechanical strainer, such as the simple Laughlin Magnetite Filter, would bring up the results to more closely approach Chicago's activated sludge results. Replying to Mr. Enslow's question,—"What B.O.D. figures were obtained, or might be expected, from efficiently settled or strained samples of the filter effluent containing the high loadings of suspended solids at Chicago?" Dr. Mohlman said that they had not thought it necessary to go beyond the ordinary plant functions, in the study, and therefore could not supply the answer.

DR. W. D. HATFIELD felt that, for small units, artificial ventilation by air blowing might be practical but for large units uniform air displacement would prove a real problem. Dr. Halvorson replied that this problem had been solved only for small units so far. He also reported that B.O.D. of 6,000 lbs. per day/acre had been removed in his experimental units. Then, Dr. Hatfield pointed out that, whereas, assisted by pre-air blowing of the applied sewage at Decatur (125 B.O.D.) only 3,000 lbs./acre/day of B.O.D. were now being removed by the filters, previous loadings had been 5,000 lbs.

Joseph Lustig, City Engr., Janesville, Wis.; Dr. C. C. Ruchhoft and P. D. McNamee, Chief Chemist and Asst. Chemist, U.S.P.H.S.

"The Gas Engine Installation at Aurora, Ill.," by WALTER A. SPERRY, Superintendent, Aurora Sanitary District, Aurora, Ill.

Mr. Sperry in describing the installation of gas engines at the Aurora plant, the economies resulting, and the ingenious automatic speed control for varying pumping rates with flow, emphasized the following points of especial interest in connection with the installation:

(1)—A reduction of engine size had been permissible and economy of fuel had resulted by direct connection to the pumps. (2)—The use of a pressure type gas storage container had provided reasonable storage capacity at a cost of three to four times less than would be necessary for the usual gravity holder. (Against $2,500 for the tanks and compressor outfit, $8,000 to $10,000 would have been expended for gravity storage.) (3)—The ability to fuel these engines with gas or gasoline

Geo. Schroepfer, Twin Cities Sewage Comm., Minneapolis. (Worked hard, won the 1937 Convention.); Arthur Morrill, Sewerage Engr., Detroit; Dr. M. Starr Nichols, Univ. Wisconsin, Madison. (Feeds "bugs" phosphorus—makes 'em wild.)

so that one may turn to either fuel at will without adjustment, contributed further insurance of uninterrupted operations. (4)—The method used for controlling the engines, with respect to varying sewage flow had given surprising simplicity and an unexpected operating range. Flows of from 3 to 12 m.g.d. had been obtained, from 8 m.g.d. pumps, operating at the variable speed obtainable through changing engine speeds with changing sewage flow absolutely automatically.

(NOTE: Mr. Sperry's paper will appear in full in a future issue of WATER WORKS AND SEWERAGE.—Ed.)

"Biochemical Oxidation by Activated Sludge," by C. C. RUCHHOFT, P. D. MCNAMEE and C. T. BUTTERFIELD, Prin. Chemist, Ass't Chemist and Prin. Bacteriologist, U. S. Public Health Service, Cincinnati, Ohio.

This excellent research paper, presented by the senior author, was too difficult to follow during its delivery to attempt to do more than record the summary as presented. The paper, which deals with the question as to what constitutes efficient activated sludge, reveals information of a basic nature. It will justify close study when it appears in "Sewage Works Journal."

In summarizing, Mr. Ruchhoft stressed the following points: (1) The substrate oxidation rate obtained with activated sludge is much higher than *natural* biochemical oxidation, being very similar to the substrate oxidation rate for pure culture sludges. The substrate

oxidizing capacity had been found to be dependent upon the quantity and biochemical condition of the sludge, rather than its physical nature or condition. Further, the rate had not been found proportional in intensity to the B.O.D. of the substrate. (2) The sludge itself always contains adsorbed and synthesized material which is undergoing oxidation simultaneously with substrate oxidation. In normal activated sludge, the quantity of oxygen required to stabilize the sludge itself had been found to vary between about 11 and 30 milligrams per gram of dry sludge during five hours of air blowing. Quantities below 11 m.g.m./gm. indicate underdosing (deficiency in sludge return), which results in impaired substrate oxidation capacities. On the other hand, sludge oxidation requirements higher than 30 m.g.m./gm. (in 5 hours) seem to indicate a "loaded" sludge in which the substrate oxidation capacity may be impaired from overdosing—i.e., indicates too great sludge recirculation. The corresponding sludge oxidation requirements for the 24 hour period for *normal* activated sludges varies from about 30 to 100 m.g.m./gm. of dry solids in the sludge. (3) In mixtures of sewage and activated sludge, of the total oxygen adsorbed that portion used to stabilize the sludge itself depends upon the quality of sewage involved, the sludge concentration, and the biochemical condition of sludge. In percentage, this varies considerably in individual sludges per cent of the 5-day B.O.D. of the substrate was oxidized in five hours.

Dr. Mohlman asked for a word as to the practical application of the findings. Dr. Ruchhoft replied that the all important observation was the 30-minute oxygen depletion created by sludges of varying activity and qualities. That, with most sludges, the minimum dry weight of sludge returned to give satisfactory results should be found to be the practice productive of maximums in efficiency and economies in operation. On the average, better than 50 per cent of the oxygen demand of the sludge (during a 6 hour period of aeration in mixed liquor) would be felt within the first 2 hours through the aerators. Tapering the aeration would be governed by the rate of oxygen consumption by the sludge proper—i.e., its degree of oxidation at the time of return and, therefore, a function of age attained in the final tanks.

Bacterial Population vs. Digestion

"Sludge Digestion—the Effect of Influenced Bacterial Population," by PAUL W. RICHARDS, Asst. Supt. of Wastes Disposal Works, Indianapolis, Ind.

Mr. Richards presented a progress report covering studies undertaken at Indianapolis to determine a possible control of rates of bacterial multiplication, and selective bacterial propagation, in order to possibly

(1) *A. E. Kimberly, Ohio's P.W.A. Engr.;* (2) *H. H. Jones, Supt. Treatment, Michigan City, Ind.;* (3) *C. C. Wilbur, Chief Engr., Minn.-St. Paul Sewerage Comm.;* (4) *W. H. Wisely, Ill. Dept. of Health;* (5) *A. J. Duvall, Minn.-St. Paul Sewerage Comm.;* (6) *L. A. Geupel, Evansville's City Engr.;* (7) *E. E. Smith, Supt. Sanitary District, Elgin, Ill.*

but of the total oxygen used by the sewage-sludge mixture, the mean percentage to stabilize sludge alone was about 39 per cent after one-half hour. After three hours of aeration the sludge requirement was still about 35 per cent of the whole and slowly increased thereafter. (4) The oxidizing efficiency on the sewage or substrate and oxygen requirement of the sludge itself was followed during the development of an activated sludge from the starting of a plant on raw sewage, with no sludge added, until a nitrifying sludge had been produced. During these tests the oxygen requirement of the sludge undergoing development in the tank slowly decreased, and the substrate oxidation efficiency increased until a normal activated sludge was produced.

Mr. Ruchhoft said that it might be concluded from the results of their studies that substrate oxidation rates by activated sludge similate the reaction velocities obtained by pure culture sludges and are very much greater than normal biochemical oxidation reactions for well aerated streams. Also, that the oxygen requirement of the sludge proper, taken together with its substrate oxidation capacity, are excellent idices of the activity or biochemical condition of the activated sludge being dealt with. At 20 deg. C. normally dosed (return rate) non-nitrifying sludges oxidize about 50 per cent of the 5-day B.O.D. of the substrate in five hours and about 30 per cent of the 20-day B.O.D. in the same period. With the most active nitrifying sludges as much as 116 hasten or otherwise modify sludge digestion. In this work, partial to fairly complete destruction of organisms in the crude and also the digesting sludge had been attained, first through chlorination, and later by pasteurization. In every case the parallel control tests in closed heated milk cans had been identical except for the sterilizing effects. The digestion period was in each case 9 days.

In test No. 1 the crude solids were treated with calcium hypochlorite until residual chlorine remained. By comparison, the gas produced was 495 cc./day from the non chlorinated vs. 457 cc. from the chlorinated solids. The gas from the chlorinated solids contained 3 per cent more of CO_2. In test No. 2 digesting sludge was withdrawn, chlorinated to a residual and returned with the new sludge. In this test CO_2 was greater from the chlorinated by 3 per cent or more. More to the point the total gas declined markedly. Then, in test No. 3, chlorine gas was added to saturate the crude sludge input and the effect was more spectacular in that gas production dropped to 264 cc./day vs. 495 cc. from the control. Loss of volatile matter was 37.2 compared to 45.2 per cent. Subsequently gas production practically ceased with the continued super-chlorination program.

Starting over again sludge input was pasteurized by heat in test No. 4 but without effect. For all practical purposes each digester yielded the same return in volume and quality of gas. Mr. Richards felt that the work

was incomplete but it was apparent that toxic effects set up by the heavily chlorinated solids had been too extreme, heat sterilization had yielded no results of moment and further work would be directed toward milder effects within the digesting sludge, looking for possible control of environment and improved digestion by selective disinfection to encourage more vigorous organism activity, if possible.

(In super chlorination of sludges, or any other organic products, one can not overlook the effects of chlorine in rendering nitrogenous bodies toxic. In addition there is the change which renders them non putrescible and thereby results in observed oxygen demand reductions and consequent loss of gas producing properties. On the contrary, a mild form of disinfection involving the gradual building up of chloramines, may be found to be responsible for increased digestion rates reported for sludges from chlorinated sewages. Mr. Richards may feel it worth the effort to take the "homeopathic" course before discarding his theories which have an appeal of basic soundness.—Ed.)

"Influence of Phosphorus and Nitrogen on Five Day Biochemical Oxygen Demand," by W. L. LEE, Asst. Chemist, and DR. M. STARR NICHOLS, Chief Chemist, State Lab. of Hygiene, Madison, Wis.

Dr. Nichols reported on his investigations, involving a comparison of the standard bicarbonate fortified dilution water and a water fortified with phosphates and ammonia salts for use in the B.O.D. test for measuring the strength of sewages and industrial wastes. Dr. Nichols' interesting findings were, that on ordinary domestic sewages and effluents the two dilution waters gave essentially check results. However, on certain industrial wastes and streams heavily polluted the Nichols water revealed oxygen demand values four fold those secured with the standard bicarbonate water. It was his contention that B.O.D. values of mixtures of sewage and industrial wastes could not be predicted on figures obtained with the standard water. Such had, in fact, been proved in his laboratory. This situation placed chemists and engineers in a poor light in the eyes of the industrialist and something should be done about the matter. The dilution water, selected as standard, should be applicable alike to all types of pollutional material.

Dr. Hatfield at Decatur had found the Nichols water to give checks with the standard on settled and crude sewages but 11 per cent higher demands on oxidized effluents. Dr. Mohlman agreed with Dr. Nichols that the markedly higher B. O. D. value of industrial wastes was more accurate than the lower and therefore for unoxidized sewages, effluents, wastes endorsed it. However, since it had produced results higher on oxidized effluents, he considered its adoption questionable and hazardous for nitrified effluents.

"Madison Improves Its Sewerage System," by H. O. LORD, Chief Engineer, Madison, Wis., Metropolitan Sewerage Commission.

Mr. Lord described the sewage treatment facilities of the Metropolitan Sanitary District of Madison where the old (Burke) sprinkling filter plant is being abandoned since the recent completion of a 5 M.G.D. activated sludge plant (see header picture), constructed alongside of, and operated in parallel with, the 5 M.G.D. Nine Springs plant completed in 1920 and consisting of Imhoff tanks and sprinkling filters.

The new plant (P.W.A. project) designed by Greeley and Hansen of Chicago, who likewise designed the sprinkling filter plant, incorporates mechanical screening, pre-aeration and grease removal, Chain Belt primary tanks. aeration tanks with diffuser plates, venturi metered air, sludge and sewage lines, rotary gas meters, floating-cover heated digesters and storage tanks in series, equipped with recording thermometers, final settlers of center feed-design equipped with "Tow-Bro" mechanisms.

Gas utilization is effected through a 200 H.P. 8-cylinder Worthington engine operating the large blower, whereas, the smaller auxiliary blower is motor driven. As a part of the new program, packing plant waste was being given chemical precipitation treatment before discharge to the municipal system.

(1) W. B. Walraven, Chief, Springfield, Ill., Sanitary District; (2) Dean Stewart, Ohio Dept. Health; (3) Carl Carpenter, City Engr., Bloomington, Ind.; (4) F. H. Whitley, Chas. DeLew Engineers, Chicago; (5) E. J. Beatty, Wis. Dept. Health; (6) W. E. Ross, Supt. America's Most Unique Activated Sludge Plant, Richmond, Ind.; (7) F. M. Logan, Indiana's P.W.A. Engr.

Mr. Lord laid some emphasis on the problem of pumping of sewage through 18,200 ft. of pressure main under head variations of 65 to 117 ft. depending upon pumping rates. This circumstance rendered selection of pumping equipment and pumping arrangements highly important from both the technical and operating economy aspects. Results from a study of various pump combination and automatic control features led to the selection of pumps of various capacities equipped with variable speed slip-ring motors, with automatic float control and regulating valve on the gravity sewers delivering to the suction well. Thus, the flow line fluctuations were being held within 2 ft. while the influent sewers were acting, during tank flow hours, as storage conduits and as free flowing sewers thereafter. All of this had been designed to minimize fluctuations in pumping rates, even up loading on treatment works, and to hold to a minimum the friction head on the 18,200 ft. main with consequent less danger of rupture from hammer, and less costly pumping.

"Janesville in the Rock River Clean-up Program," by JOS. LUSTIG, City Engineer, Janesville, Wis.

Mr. Lustig briefly described the first (P.W.A.) sewage treatment plant for Janesville (25,000 pop.) consisting of sedimentation and separate sludge digestion. The second (projected) plant would also be a primary plant and incorporate shredding of screenings, a self scouring wet-well vented through a stack, twin clarifiers, twin floating covered digesters, 500,000 cu. ft. gas holder gas engine driving a generator, and open sludge beds.

Mr. Lustig felt grateful to State P.W.A. Engineer Ferebee, for not being faced with the necessity of accepting materials and equipment bid lowest. The completed plant had cost the city only 52 per cent of the total cost.

In Janesville two trunk sewers paralleling the river had been his chief concern, because of the tremendous volume of infiltration. To reduce the cost of treatment facilities a stop-leak program (C.W.A. project) proved of paramount importance. Mr. Lustig described the method of damming the 48 inch concrete pipe sewer, in sections, in order to enter and hand-caulk the joints with oakum and lead strips. Injectors, operated on city water pressure, lifted the sewage from behind the dams and discharged below the point of caulking operations. All had been successfully completed at a reduction of the 4.5 m.g.d. flow to less than 1 m.g.d.—now, practically all sewage.

On the second (54 inch) trunk sewer, the caulking project (C.W.A.) resulted in reduction of 3 m.g.d to 1 m.g.d. flow. The next job would be an attempt to caulk a 30 inch line. The total cost had been $2.98 per joint caulked.

"Additions to the Milwaukee Sewage Treatment Works with the Aid of PWA," by JAS. L. FEREBEE, Chief Engr., Sewerage Commission, Milwaukee, Wis.

Sales Engineers and Managers

(1) *Chain Belt's Bob Steindorf;* (2) *Dorr's pioneer, Frank Bachmann;* (3) *Mathieson's Gaudin;* (4) *LinkBelt's Frank Lovett;* (5) *Simplex's "Sir" Galliard;* (6) *American Well Works' Smiling Don Walker;* (7) *Jeffrey's "steal" from Chicago, Sam Tolman.*

Mr. Ferebee described the 70 m.g.d. extensions to Milwaukee's original activated sludge plant which has operated continuously since 1925, producing 40,000 tons of "Milorganite" fertlizer annually. With the new addition the plant covers 50 acres and has a capacity of 155 m.g.d. The spiral-flow method of air input in the new plant contrasted with the ridge and furrow method of the old, and had constituted a real saving in diffuser plates. Three producers had entered into drawing specifications to cover the new plates and contract awarded 50-50 to Norton Co. and Carborundum Co. The two rows of plates, as now installed, had not proved sufficient for self cleansing in connection with the fine screened sewage given no primary sedimentation. In all feed channels, necessarily made long and large, diffuser plates prevented sedimentation of returned sludge and sewage solids. All branch air mains were of cast iron with galvanized wrought iron down-pipes to plates. Each blower was equipped with automatic cone-type checks to minimize friction.

The final settling tanks were of unique design equipped with twin revolving "Tow-Brow" suction arms for clearing the entire tank floor at each revolution if desired. The effluent take-off troughs were at right angles to the direction of flow which entered on opposite sides of the tank and flowed toward the center trough. Density of sludge drawn (1.5 per cent solids) was hand controlled through settling of elevation of riser pipes connected to the central collecting pumps.

In sludge handling, centrifugal pumps were used and ferric-chloride conditioner was now added between the pump and the vacuum filters. Advantages and savings had been noted since the change from application ahead of the pumps. To be installed was a 40 ton capacity incinerator, of the rabble arm Herreshoff type to burn screenings and grit. The present hand-stoked incinerator had been unduly laborious and costly to operate ($1.70 per m.g.). A fuel bill of $10,000 annually had driven them to make the change. Dewatering grit and screenings with centrifugals was to be continued. To reduce odor nuisance from sludge drying operations vapor condensers and scrubbers on the roof had been helpful but odors were still a problem needful of more complete solution.

Mr. Ferebee said that Milwaukee had to date spent better than $4,500,000 for sewage treatment and sludge handling facilities. The newest project was made possible through P.W.A. grants of $450,000 and $225,000.

"Sewage Plant Construction with WPA Labor," by M. W. TATLOCK, Supt., Sewage Treatment, Dayton, Ohio.

Mr. Tatlock told of progress being made with betterments to the Dayton plant, involving the construction of 20 sprinkling filters (165 ft. diameter and 7½ ft. deep) with rotary redistributors. Also 4 final settlers and 2 sludge digesters to supplement the existing Imhoff tanks already more than sufficient in settling capacity. The program had been carried through as a P.W.A. project, with Dayton's sewer rental "nest-egg" of $100,000 cash. The project, which will require an estimated $1,000,000 to complete would cost Dayton but $100,000 in cash plus the rock for the filters, but not the cost of quarrying and placing. Mr. Tatlock, acting as Resident Engineer for the city, said that considering all things the project costs looked like a contract job. He had nothing but praise for the W.P.A. Superintendent, a former contractor, who was on the job at 6:45 a. m. daily and quit at 7:15 p. m. Excavation had cost $1.07 c. yd. and concrete work $10.40. Cast iron pipe to the extent of 156 tons was involved at a cost of $92.00 per ton laid. The quickness with which materials were procured did not sound like stories he had heard about federal aid projects. He closed with a film showing the construction progress.

F. H. WARING, State Sanitary Engineer, Columbus, O., was most complimentary of the accomplishments of Mr. Tatlock and the generosity and efficiency of Ohio's P.W.A. organization in this and 850 other projects in Ohio. The application to P.W.A. had been refused on the grounds that sewer-rental charged at Dayton was not sufficient to amortize the 55 per cent loan requested. Being an ideal project for hand labor W.P.A. took on the project.

"Taking a Look at Sewage Treatment (Yesterday; Today; Tomorrow)." by LINN H. ENSLOW, Editor, WATER WORKS AND SEWERAGE.

Mr. Enslow in an illustrated talk retraced the highlights in sewage treatment history, with especial reference to American history, dating from the first genuinely planned *sanitary* sewer system in the world—that of City Engineer Chesbrough for Chicago—to the first chemical treatment plant (1887), then to the first American Imhoff tanks of 1911 and 1912 at Chatham, N. J., and Atlanta, Ga. The first known use of sludge gas was also credited to Atlanta, when in 1915 Chas. Hommon, then Superintendent of the plant, had a holder constructed and piped up his home with the gas for heat, light and cooking. The earliest activated sludge plant was that at San Marcos, Tex., and the second that at Houston, Tex., designed by Sands and Fugate. To Rusk, Texas (Theckwell as designer) he credited the first heated sludge digester, involving digester gas burning. The digester consisted of a steel tank insulated with asbestos. Pictures were shown of the earliest installation of Dorr mechanisms which marked the beginning (1919) of the age of mechanized sewage treatment works.

Sprinkling filters, starting as contact beds in England, came into being as the result of the development of Corbett's revolving distributor in 1894. The first American installation of contact beds was that in 1899 near Chicago; the first trickling filter, that at Reading, Pa., in 1908; the largest installation, that at Baltimore (1912) which has operated continuously for the past 24 years with only once being by-passed, and that because of necessary construction. Likewise in 1912 Baltimore had the earliest separate sludge digestion system of any consequence.

Concerning the activated sludge process it was Mr. Enslow's opinion that Phelps and Carpenter in their Brooklyn studies in 1910, but for intermittent operation, would probably have evolved the activated sludge process. Although American engineers are wont to credit the invention to the Lawrence, Mass., Experimental Station, courts believe it to have been developed to a usable process by England's Ardern and Lockett in 1914, and further perfected by others. First American plant, that of San Marcos, Tex., was designed by City Engineer Sands of Houston, Tex., who shortly thereafter put in the first plant of consequence at Houston. Later the Simplex (British) mechanical system came into use and, more recently, combination mechanical paddle and diffused air system, with resultant worth while power economies. Tapered aeration—the newest development—involved varying the air input to build up oxygen where most needed and trimming to economize at less critical points, beyond the half-way line through the aeration units. With all earmarks of being the most practical and logical method of aeration the future would see continually greater stress on tapered aeration and more scientific control of sludge return, based on sludge activity and sewage B.O.D., and by watching the D.O. curve through the aeration units. Return of the *least* sludge required for effective purification and maximum economy would be the future trend, in Mr. Enslow's opinion.

The newest filter development, involving continuous high-rate application (20 m.g.d./acre) to sprinkling filters, had the earmarks of a return to the beginning of activated sludge wherein aeration of submerged contact surfaces was involved, and which was simulated in Buswell's dipping de-colloider and Hays' (Waco, Tex.) submerged contact grids of aluminum, kept in condition with diffused air. As a dependable and economical unit, the sprinkling filter had so much to commend it that any development in reduced first cost and nuisance elimination was certain to return it to the popularity it once enjoyed. With the aid of chemicals and/or preaeration, much could be done with sprinkling filters not yet sufficiently explored. The Plainfield, N. J., developments and the application of iron salts in dosages of 10 p.p.m. iron, and thereabouts, to the applied sewage, such as at Atlanta, seemed to very definitely increase assimilable loadings on filter units by boosting their decolloiding performance.

Concerning gas utilization, the earliest American gas engine installations at Charlotte, N. C. (1925), and Rockville Center, L. I. (1928), had been none too successful, when in 1933 Walraven at Springfield, Ill., said that power production from sludge gas was "in the cards" and proceeded to so effectively prove that it could be done that now 50 or more plants have followed his lead. (In fact one firm alone sold 28 sludge gas units within the year. Without question the successful and paying Durham, N. C., installation (1935) also did much to stimulate rapid 1936 growth.—Ed.)

In sludge digestion two or more stage digestion seems to have too many proven advantages not to become the established method. The questions of supernatant liquor quality and digestion speed were matters of primary importance. In sludge disposal the trends away from fertilizer production and toward destruction by incineration are unmistakable and the combination of garbage and sludge incineration looks promising. Milwaukee's decision to extend its screenings incineration facilities and Chicago's plan to incinerate activated sludge, had unmistakable significance. In connection with the digestion of activated sludge, some means of sludge concentration enroute to digestion seemed of high importance and, in this, some form of inexpensive centrifugal thickening held promise as a practical scheme.

In looking forward toward the "tomorrow" in sewage treatment the increasing number of processes and combinations gave the engineer a marked range for selection but, therewith, a greater responsibility. The possibility of garbage disposal via sewers and treatment works had an appeal not to be overlooked and with conversion of the garbage solids to gas the manager of such a combination plant may well find himself in charge of a valuable by-product industry paying its way in gas power production sent out over municipal wires to pump water, light streets, etc. Mr. Enslow said that some day he expected to see the Manager of Wastes Disposal Works, that city employe who could justify a worth while salary on a commission basis out of profits.

As to industrial waste treatment and a balanced usage of American streams by industry and political entities, the present movement, such as that started on the Ohio River, toward establishing drainage authorities similar to the very workable English Rivers' Boards seemed the most promising avenue to sustained, equitable and practical solution to stream cleansing. Federal aid would go far in the matter of correlation, research and financing such worthy sectional authorities, without limitations imposed by purely political boundary lines.

On Mr. Enslow's remarks, due to the lateness of the hour, there was no discussion other than a comment by the Chairman, who thought that the speaker exhibited considerable courage in facing American sewerage authorities with the statement that the process known as Activated Sludge was to his mind an English invention.

(Adjournment.)

RAPID EMERGENCY METHOD OF THAWING HYDRANTS

By E. E. JACOBSON
Chief Engr., Lexington Water Co.
Lexington, Ky.

E. E. Jacobson

ONE of the many worries of the water works man during the cold winter months is the problem of fire hydrant maintenance and their operation when the thermometer drops below freezing.

Proper inspection and drainage of fire hydrants will eliminate most of the trouble but hydrants only a few days after inspection have been found to contain water in the barrel. As the weather turns cold the water in the barrel becomes ice and the hydrant will not operate. No doubt every water works superintendent in states that have cold winters has experienced frozen fire hydrants.

The method used in Lexington, Ky., for a number of years as an emergency method of thawing ice from hydrant barrels is by pouring concentrated sulphuric acid into the hydrant barrel. During the Fall each piece of apparatus of the Lexington Fire Department is supplied with a quart bottle of sulphuric acid (66% commercial). When the acid is used the Lexington Water Company is notified and another bottle is sent to the fire station. In the Spring of the year these bottles are collected and fresh acid is issued each Fall.

When answering an alarm and a hydrant is found to be frozen, the acid is poured into the barrel through the nozzle and a slight pressure put on the stem operating wrench. As soon as the heat produced by the acid drills a hole through the ice cake the hydrant is opened, flushing out the acid with the first gush of water.

In frozen hydrants we have found that the ice forms first above the valve and in most cases it is doubtful if the acid reaches the valve because the stem turns and the water is turned on as soon as the ice melts around the stem.

The average time for thawing hydrants with acid is about three minutes although this would depend upon the thickness of ice in the barrel of the hydrant, and might vary considerably from the above time if very thick.

The advantages from this method of thawing hydrants comprise the ease of handling the thawing material on the fire trucks, the small space necessary on the truck, simple to use, inexpensive, and the rapidity of results. Hydrants in which acid was used have been taken apart and no ill effects to the hydrant parts could be found.

The effectiveness in the use of sulphuric acid for this purpose may be determined by the following letter from the Chief of the Lexington Fire Department:

Mr. E. E. Jacobson, Chief Engineer — April 11, 1936.
Lexington Water Company
Lexington, Kentucky.
Dear Mr. Jacobson:

Relative to our conversation this morning, I am furnishing you with all the information that I have in regards to the use of sulphuric acid in thawing fire hydrants during extreme cold weather.

In case a hydrant is found to be frozen, one of the caps of the hydrant is removed and a quart of acid is dumped into the barrel of the hydrant. The suction hose is then replaced on the hydrant, and in the majority of the cases the hydrant is thawed out by the time the suction is replaced, and the hydrant is turned on. The water and acid is allowed to flush out through the pumper or the hose, and we have found that little or no damage is caused by this action, due to the fact that the acid is neutralized by water to such a degree that it is harmless to the pumper or the hose.

In some instances the acid is a little slow about thawing the hydrant, but in these cases it is usually in certain parts of the city, where the surface water seeps in the barrel of the hydrant, causing the hydrant to have more water than usual in the barrel, but as soon as these hydrants are found, your company has had them filled with alcohol, thereby eliminating this trouble.

You will notice that we say that we replace the suction or the hose to the hydrant before we turn on the water. This is done to prevent acid burns to members of the department and the hose and apparatus that is near the hydrant. The first spurt of acid and water from the hydrant would be dangerous to any thing that it touched, but by replacing the cap, the acid is diluted with the water to a point where it is practically harmless to any thing it might touch.

It has required from two to eight minutes to thaw a hydrant with acid, where it usually requires about ten minutes to thaw out a hydrant with a regular thawing device, old style thawing device.

A test was made at fire department headquarters today. A fifty pound block of ice was used and one quart of sulphuric acid was poured into a hole in the ice. Ten minutes later a hole was burned in the ice eight inches deep, six inches wide and ten inches long. Of course, this was a little longer than it would have been in a hydrant, due to the fact that acid will follow the stem of the hydrant and penetrate into the ice faster than it did during the test. We have found the use of sulphuric acid for thawing hydrants to be most satisfactory.

C. J. HENRY,
Chief, Lexington Fire Department.

Tom Veatch Heads Missouri Valley Section

N. T. Veatch, Jr.

At its recent Annual Convention, held in Kansas City, Mo., the Missouri Valley Section of A. W. W. A. elected as its new Chairman, N. T. Veatch, Jr., of Black and Veatch, Engineers, Kansas City, Mo. The new Vice-Chairman is Dale Maffitt, Manager, DesMoines, Ia., Water Department.

Second only to the California Section in size, the convention, the Missouri Valley Section registered an attendance of 322 at the Kansas City meeting, which E. L. Filby, Chairman of Committee on Arrangements, reports to have been the most successful meeting ever held by the section.

Elected to the Board of Directors of the section were: W. W. Towne (South Dakota); Bernard Ulrich (Kansas); Walter Molis (Iowa); Rex Henry (Nebraska); W. V. Weir (Missouri). The Secretary of long standing is Professor Earle Waterman, Iowa City, Ia.

PENNA. WATER WORKS ASS'N HOLDS 45TH ANNUAL MEETING

IN CUSTOMARY business-like fashion the Pennsylvania Water Works Association, with a registration of 135, conducted its 45th Annual Convention in Atlantic City, N. J., on October 14th, 15th, and 16th.* The association is composed of managers, chief engineers, attorneys, and other executive officers of 141 water companies in the State of Pennsylvania.

High Lights on the Program

So rich in quality of speakers and subject matter was the technical program that it is difficult to single out the high-points of the proceedings. We would be remiss, however, if we did not give high rank to that splendid philosophical and thought provoking paper—"Utilities and the Public"—so sincerely and forcefully presented by Edward O. Tabor, Pittsburgh Attorney at Law.

Two addresses of high order were delivered by Dr. H. W. Temple of Washington and Jefferson College, Washington, Pa., a former member of the U. S. House of Representatives and long Chairman of its Committee on Foreign Affairs. His first topic was "Business Organizations and Legislation" which dealt with the over abundance of Federal and State legislation directed at the control of business enterprise—especially public service enterprises and utilities. In preparing legislative acts, he stressed the good and the bad in lobbyists' efforts within, and without, committee hearings. In his second address of a heart-to-heart style Dr. Temple, in presenting some of the history behind "The Present Crisis," pictured folly and dangers in the trend of the present day in which experiments and leftists were attempting to ignore or overthrow all past experience and take up the absolutely untried.

An enlightening and worthy discussion of its underlying elements and the aftermath of "Inflation and What It Will Mean to Water Companies," was presented by Dr. Frank Parker, University of Pennsylvania's Professor of Finance. Concluding that no real inflation of hysteria type seemed in prospect, he warned that none the less extended and continued government borrowings always constituted a threat in the development of a creeping or incipient type of inflation, already partially established with the dollar devaluation. If further inflation appeared, especially hard would the effect be on utilities forced to pay more dollars for equipment and to meet wage increases, without being able to increase the rates charged existing consumers or locate takers to make possible increased plant output.

*This report, prepared for the November issue, could not be used therein. After meeting requirements, based on priority, the remaining space proved inadequate.—Editor.

The President
John H. Murdoch, Jr.

The Secretary
Dr. F. Herbert Snow

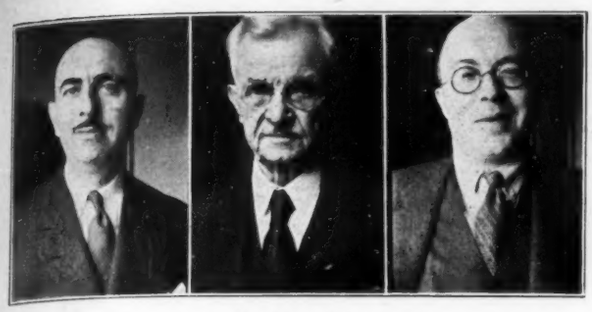
No. 1 Speakers and Prize Asst. Secy.
Edw. O. Tabor, Pittsburgh Attorney; Lillian E. Wolfe, Treas. and Asst. Secy.; Joseph A. Beck, Pittsburgh Attorney.

Management that Succeeds

Before this group of high officials in water company management came an outsider who, however, seemed to have the "inside" when it came to his evaluation of what constituted the really successful type of water works manager. In his analysis of "The Manager's Job in Relation to the Public and the Public Utility Field," Ralph B. Cooney, of New York City, with a background gained in the real-estate field, drew a picture of the really successful manager as the man who thought more-and-more about the future of the community he served and less-and-less about politics or his company's immediate welfare. Looking ahead toward bettering the community, and assuming some form of community leadership, was his most important present day role. Further, the smaller the municipality the more important were the manager's acts when dealing with the public. Appearances and sincerity of the manager were more important issues than that of a smiling cashier at the receiving window. Making the water utility a part of the community was more important in present-day trends and clamor for public ownership of utilities than was the consideration of the headquarters offices of so-called chain companies. Representation on the Board of Directors of the company in the form of local citizens had its definite merit. "Forget the Company, and remember the company you keep," constituted a high spot in Mr. Cooney's advice to the manager who would succeed by participation in community-service on a personal leadership basis. In other words, the keynote struck was: That in considering the well-being, the happiness and security of the company owned water utility, "Main Street" means far more than does "Wall Street." The manager who kept this thought in mind was always the most successful manager.

Beck, on Utility Regulation

In that clean-cut fashion, which is so direct as to demand attention whenever he speaks, Joseph A. Beck, well known Pittsburgh attorney, frequently appearing for water companies before regulatory commis-



Also Excellent

H. Gordon Calder, Vice Pres., Scranton Water Co.; Dr. H. W. Temple, W & J College, Washington, Pa.; Ralph B. Cooney, "Public Utilities Fortnightly," New York City.

sions, outlined the "Developments During the Year in Attempted Utility Regulation by State and Federal Agencies." He cited the St. Joseph, Mo., case in which the U. S. Supreme Court decision establishes the right of independent judgment of the court in ruling on evaluation and rate cases—a highly important principle in law. He pointed out, however, that three members, in a minority report, give most weight to the State Commission findings. In another important case a State Supreme Court had held that officials of the municipality had the power to represent all consumers in dealings with the company owned water utility before utility commissions. He also reported that efforts, by municipal authorities constructing a competing utility and attempting to oust established companies, had been unsuccessful in Illinois and Missouri. Concerning Federal grants to finance municipal plants to compete with established utility companies, the lower courts had so far held such practice to be unconstitutional. The answer, in the end, would center around the question of justification, based on possible public benefit. Public ownership, theoretically more economical in interest charges and operating costs, due to municipal financing and operation, the real question was: Will the public at large benefit by such savings?"

Concerning the future so-called holding companies, Mr. Beck cited the advantages of possible higher efficiency in operation and management and greater economies. The one barrier was the important consideration, so distasteful to the public at large, of too great concentration of wealth and draining away of local funds to the large financial centers from which holding companies reach out.

Utilities and the Public

In his outstanding analysis of America's present attitude to the older order of things, in general, and specifically, as related to public versus private ownership and management, Edward O. Tabor, Pittsburgh attorney, forcefully pointed to the fact that America, during its years of development, had represented a "process" as well as a place. In pioneering days the average American was far less dependent upon organization than is the case today. As a result, processes and procedures of that era developed a so-called "individual ruggedism" which no longer fits the present day philosophy. Under true democracy it seemed inescapable, considering that 80 per cent of America's population now was working for wages, to conclude that America's capitalistic methods must be improved upon. With it, the establishing of social and economic security provisions were likewise inescapable. As a governmental, rather than private function, industry will without doubt come to consider the now objectionable social-security movements in the same category as the once despised Workmen's Compensation Acts are now considered—i.e., as beneficial to the whole people. That the establishment of Social Security Regulations would be at the expense of some loss of liberty was inevitable, and the minimum of this important loss was the end to be gained by examining and learning from similar and earlier developments abroad. The aim of every red-blooded American should be to the end that America, like England, can make democracy work without the type of regimentation such as is now in progress in certain parts of the world. And, to this end, sound thinking must supersede emotionalism in future planning.

Public utilities had come to be considered a "bloc" in our national life, said Mr. Tabor, and an effective statement of policy on the part of the utilities group was an essential step toward clean-cut understandings. There was no denial that utilities were entitled to a fair return, but only on *honest* values. Favoritism in all quarters must be considered taboo; and, as true now as ever, was the inescapable fact that decent and fair dealings with the public lead to dividends in the end. Two essentials in the future welfare and progress of America seemed to be "freedom along with social security," and "democracy along with capitalism." How best to attain these combinations, in the future building of the Nation, was to be decided largely by the people. The right to alter the Constitution, if that seemed the necessary step, was theirs to assert. But, cautioned Mr. Tabor, that right should be jealously guarded if a *true* democracy was to continue and the pit-falls of European regimentation were to be avoided by freedom-loving Americans.

Commission Regulations—Success or Failure

DR. F. HERBERT SNOW, Secretary of the Association, a former Chief Engineer of Pennsylvania's Public Service Commission, traced, in an analytical manner, the history of commission regulation and summed up the good and the bad therein, by answering the question, "Has Commission Regulation Failed?" Established for the prime purpose of getting reductions in utility rates, the early regulatory acts were principally plays to the grandstands. With gradual improvement in methods, involving conferences designed to insure a fair deal to the utility, as well as the public served, one could now state with conviction that commission regulation had reduced rates, bettered service, engendered consumer good-will. The answer was that such regulation, subject to some further improvement possibly, had *not* failed.

To E. E. BANKSON of Chester Engineers, Pittsburgh,

Add to Any Program

E. E. Bankson, Consulting Engr., Pittsburgh; N. B. Jacobs, Consulting Engr., Pittsburgh (Vice Pres. of the Assn.); W. C. Hawley, Mgr. Penna. Water Co., Wilkinsburg (Long Chairman Exec. Committee).

Managers, Presidents, Vice-Presidents

(1) *Chas. Boas (Reading)*; (2) *Dan J. McGeehin (Hazelton)*; (3) *Philip Dixon (St. Marys)*; (4) *E. R. Hannum (Windber)*; (5) *D. C. Morrow (Washington)*; (6) *H. E. Flory (Nazareth)*; (7) *W. W. Levering (Lansdale Water Co., Phila.)*.

was assigned the question "Can Commission Regulation Be Improved?" In his answer, he pointed out the advances made by the Ohio Commission in its improved requirements, resulting in eliminating maneuvers, reducing delays, and precluding "shadow-boxing" in connection with rate-case hearings. A feature of great value, in eliminating "bunk" or misinterpretation and "monkey-business" in direct and cross-examination of experts, was found in the requirement that all expert testimony must be reduced to writing by the expert and turned in well in advance. Thereafter, "informal" hearings were required before proceeding to the formal and recorded hearings. Result, strategic delays and long drawn out litigation had been avoided. In the matter of evaluations in rate cases some states require that the commission make the examinations and prepare inventory data (Missouri doing a very thorough job of it), whereas others, including Pennsylvania, places the expense of employing experts on the utility company. Ohio was requiring minute supporting data which, thereby, had reduced to a minimum the questionable evidence of estimated values and arguments based on inadequate facts.

Mr. Bankson stressed the desirabliity of more effective technical record keeping, in the matter of permanent betterments, for the purpose of establishing physical quantities and qualities, rather than the dollar value, at the time of making the improvements. With such, the existing or replacement value might be computed at any future time, regardless of the fluctuating dollar value.

Supporting Mr. Bankson's plea for physical property accounting, Philip Burgess (Columbus, O.) stressed the reduced expense to all concerned in valuation hearings. M. B. Jacobs (Pittsburgh, Pa.) explained the machine method used by electric utilities in such accounting practice. (A committee is to be established in the Penna. Water Works Assn. to further investigate and report on the practicability and relative cost of physical property accounting in water works operation.—Ed.)

Flood Symposium

Your reporter, unable to reach the meeting in time, can not report the "Symposium on the 1936 floods in Pennsylvania." In charge was W. C. Hawley of Wilkinsburg, Pa., and participants were E. A. Geehan on "Operating Difficulties at South Pittsburgh"; John W. Birkinbine on "Economic Aspects of Flood Control"; W. L. Stevenson on "Public Health Aspects of the Flood"; R. E. Turner on "Flood Forecasting."

Also, it is regretted that the detailed paper by H. Gordon Calder, Wilkesbarre, Pa., on "Taxation," and the review of "Recent Developments in Pennsylvania Utilities Law," by B. H. Evans of Harrisburg, do not lend themselves to satisfactory reporting in the space available.

Officers Named

Officers serving during 1935-36 were all unanimously retained for the ensuing year.

President—John H. Murdoch, Jr.,* American Water Works & Electric Co., New York City.

1st Vice-Pres.—Wm. H. Miller, Jr., Lewiston Water Co., Reading, Pa.

2nd Vice-Pres.—Nathan B. Jacobs, Morris Knowles, Engrs., Pittsburgh, Pa.

3rd Vice-Pres.—J. B. Neveling, Clearfield Water Co., Clearfield, Pa.

Secretary—Dr. F. H. Snow, Telegraph Building, Harrisburg, Pa.

Ass't Sec'y—Lillian E. Wolfe, Telegraph Bldg., Harrisburg, Pa.

Chairman Exec. Committee—W. C. Hawley, Penna. Water Co., Wilkinsburg, Pa.

*Until recently with Community Water Service Co., Washington, Pa. As president, Mr. Murdoch is now serving his fifth consecutive term.

All Wear Good Hats—Some "Brass" Ones

(1) *A. N. Burnie (Beaver Falls)*; (2) *I. M. Glace (Harrisburg)*; (3) *F. S. Friel (Philadelphia)*; (4) *Harry Freeburn, (Philadelphia)*; (5) *Edw. Aicher (Easton)*; (6) *Homer Beckwith (Harrisburg)*; (7) *Jim Eaton (Amer. Water Works & Elec., New York City)*.

SOME "KINKS" IN THE OPERATION OF A WATER SYSTEM

The First of Two Contributions of Kinks Found Useful by the Author

By CARL A. HECHMER*
Hyattsville, Md.

A Surface Skimmer

AN EFFECTIVE MEANS of skimming leaves and trash from the surface of the water at the intake screens has been in use for some time at our Robert B. Morse Filter Plant. Logs about 6 inches in diameter and six feet long are fastened together, end to end, by rope couplings and floated on top of the water about 15 to 20 feet from the intake screens. Being built of short 6 foot sections makes the skimmer easy to handle. Being flexible, it moves with the wave motion of the water and it can be fastened at any angle to make it self cleaning. Changing elevations of the water in the reservoir have no effect on the skimmer as the logs always ride on the surface of the water, partly submerged. This same arrangement has been installed across the inlet end of the preliminary sedimentation basin, being fastened straight across and about 15 feet from the inlet end.

The Author

Thawing Fire Hydrants

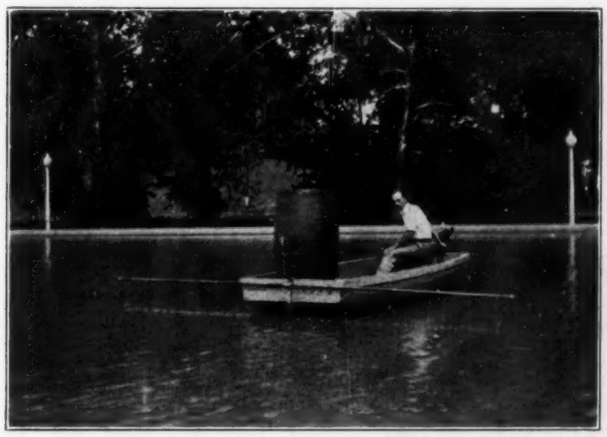
For thawing fire hydrants the use of calcium carbide is suggested. Use the ordinary lump carbide such as is used in gas lamps. Drop several lumps onto the top of the ice through the outlet nozzles. The carbide immediately cuts a hole down through the ice due to the heat generated allowing the water to start. The flowing water soon removes the ice from the hydrant barrel. Sulphuric acid of the ordinary commercial strength may also be used for this purpose in the same manner as described above. Some Fire Departments carry a bottle of sulphuric acid on the fire engine and empty the contents into the frozen hydrant. A pint bottle will contain sufficient acid to thaw the amount of ice ordinarily encountered. The rush of water clears the hydrant before damage can be done by the acid.

Hydrant Maintenance

The Washington Suburban Sanitary District is protected entirely by volunteer fire companies. Considerable difficulty has been experienced in obtaining notification after hydrants are used either for practice or fire fighting, so that inspection can be made by the Water Department to insure the proper condition of the hydrants. After use, such notification is especially desirable when volunteer companies use the hydrants because the operation of the hydrants is usually not done by an experienced or trained man. To require a telephone notification would mean a cost of five to ten cents each time which would impose a hardship on the "firemen." This difficulty has been overcome by the use of a post card system. Post cards, self addressed and with a suitable form on the message side, are furnished the various fire companies in lots of twenty-five. Each time a hydrant is used its location is noted on the card by the "chief" and dropped into the nearest mail box. The card is received the following day and usually the inspection can be made within 24 hours. This method has proven very satisfactory and all hydrants, thus reported, are promptly inspected. This, together with the regular inspection every four months, has resulted in an excellent record for fire hydrant performance in the District.

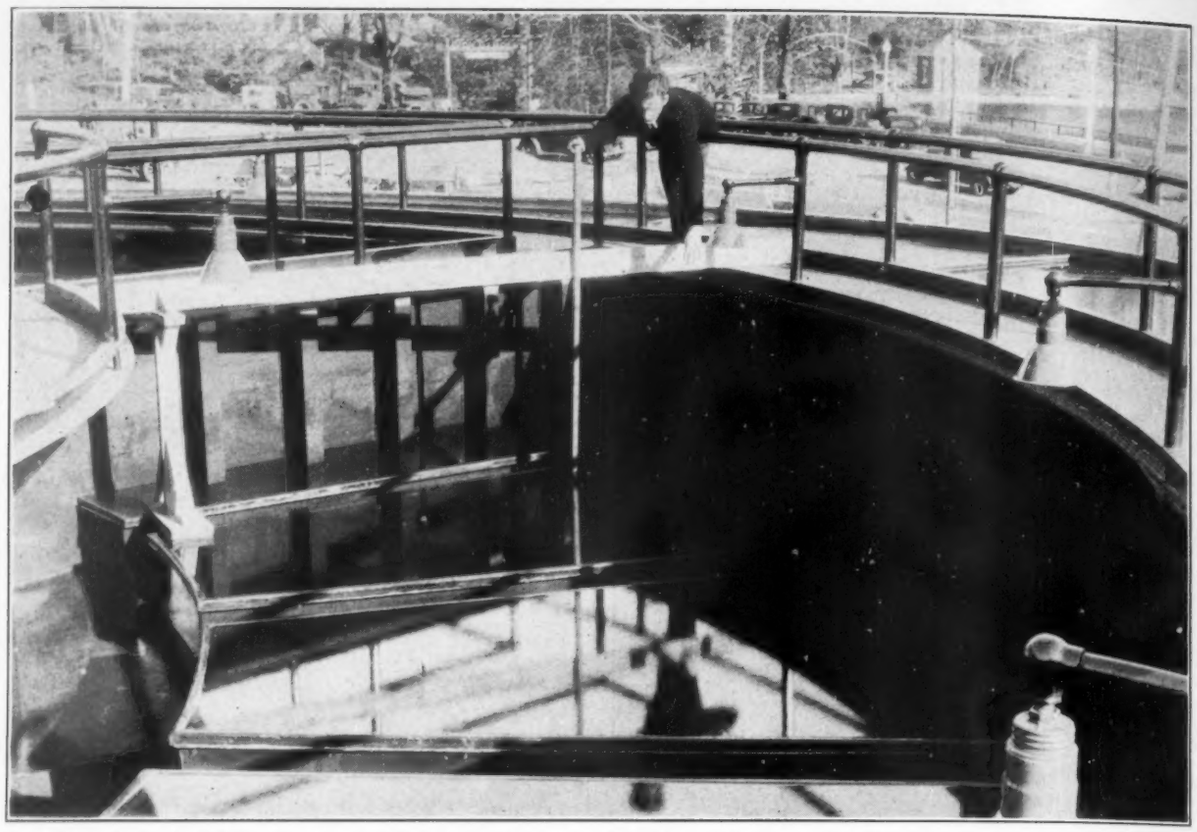
Hydrant Operation

Another suggestion can be made regarding the operation of fire hydrants during freezing weather. Difficulty is frequently experienced getting a hydrant stem to start opening due to the condensation in the stuffing box gland becoming frozen and clinging fast to the stem shaft. An inexperienced fireman will place the wrench on the chilled hydrant operating nut and give it a sudden hard pull. If the nut will not move he probably will get another man or two to pull with him or he will place a pipe lever on the wrench, generally doing both. The result is a broken fire hydrant wrench, delay in moving to another fire hydrant, and then complaints of an inoperative frozen hydrant. Carbide or sulphuric acid will not release a fire hydrant which has become stuck in this manner. Without exception the following simple instructions have been successful in opening a hydrant in this condition with no delay: Tap the top nut of the fire hydrant several times with the hydrant wrench before attempting to open the hydrant. The vibration thus imparted to the valve stem shakes the frozen packing loose from the stem shaft and the hydrant will open without any trouble.



Surface Treating Scheme for Algae Control.

*Department Engineer, in Charge of Maintenance and Operation, Washington Suburban Sanitary District.



Rod for Testing Condition of Filter Bed and Effectiveness of Washing. Note Operator Reading Bed Elevations with Aid of Portable Straight-Edge and Rod Markings.

Washing Filters

A method for determining the effectiveness of wash water rates at our Robert B. Morse Filtration Plant has been in use for several years with excellent results. A rod, of sufficient length to be held by the filter operator on the operating floor or walk at the edge of the filter is used. To the bottom a block of wood two inches thick and about 8 inches square is attached. This rod is calibrated and marked for normal sand depth and for maximum depth with sand expanded. With the filter in normal operation the elevation of the sand can be checked by placing a straight edge across the filter and testing the mark on the rod for correct sand depth. If the sand is not at its right elevation over the entire bed the observer will immediately observe this without drawing down the water level. While the filter is being washed the observer continues to probe the sand bed with the testing rod. The sand being in suspension allows the flat block to penetrate through the sand to the top of the gravel if the filter is washing properly. If hard spots are present this test locates them as soon as they start to form and corrective steps can be taken before the condition of the filter bed is seriously impaired. If the wash water rate is too low the test rod will not penetrate the entire sand depth; if too high, the gradual loss in sand depth (increase in free-board depth) will reveal this fact.

Controlling Hydraulic Valve Operation

To prevent excessive wash water through our filters, we have fixed the wash water valves so they cannot be opened beyond the point where the desired amount of water will be delivered. At the present time we are using a rate of 12 gallons per square foot per minute and a valve opening slightly more than half-way will deliver the correct amount. To insure the proper valve opening each time the filter is washed, a piece of pipe equal in length to the unopened travel of the valve was placed around the valve stem above the gate. The pipe prevents the gate from going beyond the set opening, as determined from tests, and the operator cannot wash at an excessive rate. This same arrangement can be used in controlling the maximum opening of any hydraulic valve where a partial opening is required.

Surface Treatment for Algae Control

For surface treatment of water in a reservoir or sedimentation basin we are using a wooden barrel with a three-quarter inch pipe and valve tapped in about six inches from the bottom, with two 6 foot lengths of one-half inch copper pipe extending either side of the valve from a tee—see accompanying picture. The half inch pipes are drilled with ⅛ inch holes spaced 4 inches apart. Chemical solutions of the proper strength are made up in the barrel, which is placed in the front end of a skiff or boat. As the solution sprays out of the perforated pipes the operator runs the boat up and down in 12 foot lanes thus covering the entire surface.

Note: This scheme of treatment, using hypochlorite solution to give a dosage of 1.0 p.p.m. of chlorine, has been very effective in treatment for the elimination of protozoa of the Euglena E. Viridir type. We have been troubled with this form of algae at our Robert B. Morse Plant during hot spells, the water temperature rising to 78 degrees at times. The characteristic reddish green scum appears very suddenly, often entirely covering the basins in from four to six hours with a greenish skim. The chlorine treatment has removed this growth in from one to two hours, although it reappears in a day or two.

[A second contribution of the always useful "Kinks" from Mr. Hechmer will appear in a near future issue. —Ed.]

COAGULATION

Part 1: Introduction and Methods of Conducting Tests

By JOHN R. BAYLIS*

Associate Editor

This is the first of a series of articles dealing with coagulating chemicals which are commonly used in the treatment of public water supplies, such as aluminum sulfate and the iron compounds. These substances already have received so much consideration in the past that many may wonder if anything of value may now be disclosed by an investigation of their reactions. The purpose is to show the effect of each factor which influences the formation of the coagulation, and it is hoped that these influences will be presented in a manner which may be readily understood by those operating water treatment plants. This does not imply criticism of the vast amount of excellent work which has been done on coagulation by many workers, but so much of the past work has been done under conditions wherein the results were effected by several influences that much of the information has been difficult to apply in practice.—The Author.

John R. Baylis

THE forthcoming articles do not present information which will enable every one to determine their most effective treatment without resorting to experimentation on the particular water. The hope is that with a better understanding of the influencing factors the task of finding the most suitable treatment will not be so difficult. The experiments which will be recounted divulge new data, and while some of it merely confirms facts already known, the importance of the subject — "Coagulation" — justifies a lengthy discussion.

One new fact has been established, and that is, that silicon has a considerable influence on coagulation with aluminum sulfate and the iron compounds commonly used in water treatment. So far as the writer is aware this fact has not been disclosed heretofore. Or, if so, no emphasis has been placed on this important fact.

Method of Conducting Tests

Tests Conducted in Laboratory.—The experiments were conducted in the laboratory, and while laboratory tests may not duplicate exactly the results in treatment plants, there is not a great deal of difference when they are conducted properly. Laboratory experiments are necessary in an investigation involving so many variations in the constituents of the water as were studied. A large number of tests were made with distilled water to which definite amounts of certain substances were added to the water. Lake Michigan water was also used extensively in the tests. Samples of water from a few other sources were used in some of the experiments.

Stirring the Samples.—The solutions were prepared and in most instances added to one-liter samples in beakers, for stirring. The coagulant, unless otherwise stated, was added after the stirring had been started to assure fairly rapid mixing of the chemicals with the water. The stirring machine had six stirrers, and unless otherwise stated the stirrers were operated at about 90 r.p.m. Each stirring rod contained two blades at the lower end, one-half inch wide and 1.5 inches long. This gave a tip-end velocity of the stirrer blades of slightly more than one foot per second. The velocity imparted to the water was believed to have been between 0.5 and 0.8 ft. per second. At least it was a velocity which gave good coagulation of the water in about the minimum stirring time, and produced large flocculated particles when the water was treated with sufficient coagulant.

Observations During the Stirring Period.—The beakers were examined at definite intervals in a manner which readily detected the first stages of coagulation, if present. As the stirring machine contained six stirrers, many of the experiments were made by running all of the stirrers at one time. By timing the addition of the coagulant to correspond with the rate at which the beakers could be observed for coagulation, each beaker could be examined within a few seconds of the desired time. When the coagulation rate was slow, the beakers usually were examined at intervals of 5, 7.5, 10, 12.5, 15, 20, 25, 30, 40, 50, 60, 75, 90, and 120 minutes after the addition of the coagulant. When the coagulation rate was rapid, the beakers were examined more frequently, and usually only one or two samples were stirred at one time.

Preparation of Stock Solutions of Alkalies.—Calcium bicarbonate solutions were prepared by passing carbon dioxide through water containing a suspension of calcium carbonate. Efforts were made to prepare solutions containing 200 to 300 p.p.m. of calcium bicarbonate. The suspended calcium carbonate was removed by filtration, filtering the solution into a bottle so that it could be closed. By having considerable excess of carbon dioxide in the water, enough was present to be given off in the bottle so that equilibrium would be established between the air in the bottle and the water and there still would be enough left in solution to keep the calcium bicarbonate from precipitating. Definite amounts of the stock solution were diluted with distilled water to produce the desired alkali concentration in the sample. Magnesium carbonate plus bicarbonate was prepared in the same manner, except it was not necessary to carbonate so extensively to produce a stock solution of the desired strength. More soluble substances like sodium bicarbonate were prepared in solutions having a convenient strength.

Turbidity of the Samples.—Many of the experiments were made with a turbidity of approximately 30, using Fuller's earth for the applied turbidity. Other experi-

*Physical Chemist, Division of Water Purification, Department of Public Works, City of Chicago.

ments were made on turbid water, or water containing a slight turbidity in which there was no added turbidity. One reason for adding turbidity when the water was clear was to aid in detecting the coagulation when it first began to form. Also the character of the flocculation could be judged more accurately when some turbidity had been coagulated with it. The reason for using Fuller's earth in so many of the tests was for the sake of limiting variables and enhancing uniformity. The suspension of the earth was prepared by adding several grams of it to a two-liter flask, and filling nearly full with distilled water. The mixture was agitated a number of times within a period of about 30 minutes, then it was allowed to stand about 30 minutes and the supernatant liquid poured off. Usually a turbidity of 1,000 to 1,500 remained in the liquid poured off. This was tested, and the proper quantities added to the samples before dilution to the desired volume.

Addition of the Coagulant.—Usually all substances except the coagulant were added into a measuring flask or cylinder graduate and diluted to the desired volume. Most of the tests were made with one-liter portions. The coagulants were dissolved in water and, where possible, were made to such strength solutions as would require not more than 10 cc. of the chemical solution to one-liter portions of water. Where it was necessary to test the samples of water for substances such as carbon dioxide or alkalinity before the addition of the coagulant, more than one liter of the sample was prepared to permit the desired withdrawals. This also was done where it was thought that more than one pH test would have to be made before the addition of the coagulant. Unless great accuracy is desired, the removal of 10 cc. of solution from one liter for making a pH test is of no significance. This, however, was taken into consideration in some of the tests by preparing more than one liter of the water and reducing the volume to one liter before the addition of the coagulant.

pH Tests.—LaMotte color standards were used in making the pH tests. It is realized that the tests made in this manner may not be exact, but they are close enough for all practical purposes. Most of the test had to be made quickly. The error probably did not amount to more than 0.1 pH in any of the tests. pH tests were made between the time of one minute after adding the coagulant and about 5 minutes, but are given in the tables as being made at 5 minutes afterwards. Other pH tests were made after stirring 30 minutes and after stirring 90 minutes, unless an excellent coagulation was produced prior to these times. The samples were stirred in open beakers, and the pH frequently changed some during the stirring period.

Filtering Samples.—In many instances the samples after stirring were filtered and the turbidity of the filtrate determined. Cotton plugs in funnels were used for the filters. The cotton plug filter gives results close to that of sand filters. The procedure was to take a small wad of absorbent cotton about one inch in diameter, when wadded dry in the hand and then turned loose. It was placed in the funnel, which was about 4 inches in diameter, and pressed down with a stirring rod and held until the funnel was nearly filled with water. After the cotton was wet thoroughly it was again pressed down with the stirring rod so that the rate of filtering was about 50 to 75 cc. per minute with the funnel nearly full of water. About 100 cc. of the first solution passing through the cotton plug was discarded.

Distilled Water.—Most of the distilled water used in the experiments was from a Barnstead distilling apparatus, though in a few instances glass distilling apparatus was used.

Classifying the Coagulation.—This was the most difficult procedure to decide upon. No method of classifying which we know of is free from all objections. The arrangement of the windows in the laboratory enabled good detection of the coagulation by holding the beaker between the observer and the window. Each stirrer on the machine could be stopped without stopping the others. To stop a stirrer, make an observation, and start the stirrer again, required about 15 to 20 seconds. The appearance of the coagulation was classified as follows:

1. None

   No coagulation visible.

2. Just visible

   Coagulation could be observed, though the individual particles were very small. Such coagulation settles very little within the period of one hour.

3. Fine particles

   The coagulated particles were large enough to be readily observed. There was considerable settlement on standing one hour.

4. Fairly good

   The largest flocculated particles probably were 0.3 to 0.5 mm. dia. Usually about 75 to 85 per cent of the coagulated matter settled in one hour.

5. Good

   The largest coagulated particles were about 0.5 to 0.8 mm. dia., and the settling rate was fairly rapid.

6. Excellent

   There were large coagulated particles ranging in size up to 1.0 mm. dia., and sometimes slightly larger.

As this method of classifying the coagulation is subject to variations, when observations are made by different observers, one person made all of the observations on the samples in the experiments which are to be recounted. The results at least should be comparative. On filtering through a plug of cotton, the coagulation marked "just visible" never filtered clear, unless the stirring period was too short, and longer periods would have formed a better coagulation. The coagulation classified "small particles" sometimes filtered clear, but usually there was some turbidity remaining after filtration. The coagulation might be classified "good" and the filtrate still contain some turbidity. This is the case when insufficient coagulant is added to entrap all of the very small suspended particles. The main measure of the coagulation was the size of the coagulated particles. In most instances the coagulation marked "fairly good," to "excellent," filtered perfectly clear. A classification of "immense" was used in a few instances when silicon was added to the water to denote that the coagulated particles were much larger than the size usually classified "excellent."

Part 2: Effect of Silicon on Aluminum Hydroxide Coagulation

Probably the most important fact which has been established by the experiments is the remarkable influence of compounds of silicon on the formation of aluminum hydroxide coagulation. This is being placed first in the discussion, for much of the data which will follow are influenced by the effect of silicon. It is too soon to state what effect this discovery will have on the coagulation of water in the future, but it suggests that silicon can be used to aid the coagulation in many filtration plants. This may be especially true for waters difficult to coagulate.

How the Effect of Silicon Was Discovered.—Some time ago a series of experiments were started on coagulation. Solutions containing known amounts of certain substances such as calcium carbonate, magnesium carbonate, and many other salts were used. There was a marked difference between the results obtained with the prepared solutions compared to those with natural waters. Even rain water, collected from the gutter of a roof, showed considerable difference from distilled water when known amounts of such substances as calcium carbonate were added. At first it was thought that distillation of the Lake Michigan water may have carried over something in the distillate which retarded coagulation, or that there was enough metal imparted to the water from the Barnstead still to have some effect.

Re-distilling the water in glass with glass condensers, however, did not alter the results. Water from other sources was distilled in glass, and it gave results approximately those with the distilled lake water from a metal still. This possible cause being eliminated, the results could be explained only in that there was some common substance in the natural waters which was not in the distilled water. Some of the experiments which showed such a great difference between distilled water with added alkalies and natural waters, and inspired the search for the cause, will be given in a later article.

Rain water collected in Chicago in the manner described contained several parts per million of sulfates, so this was then thought to be the cause for it producing better coagulation than distilled water when equal amounts of alkali and coagulant were used. Soon this was proven not to be the cause, for increasing the sulfates had no appreciable influence other than could be explained by increasing the concentration of certain salts in the water. When the same amount of sulfate that was found in the rain water was added to distilled water there was no noticeable improvement in the coagulation.

Diluting the clear Lake Michigan water, which has an alkalinity of 120, with distilled water, the unknown substance aided coagulation up to the point of great dilution. The aiding effect did not drop off rapidly until the proportion of lake water was reduced below about 17 per cent. The effect of diluting the lake water with distilled water, and adding calcium carbonate to maintain the alkalinity at about 20 when the dilution reduced the natural alkalinity below this point, is shown in Table 1. Note that when the lake water was diluted to an alkalinity of 20 to 22, an excellent coagulation, using 10 p.p.m. of aluminum sulfate, was formed in only 12.5 minutes of stirring, whereas the lake water without dilution required 10 minutes to form an equal coagulation.

The mineral analysis of the lake water revealed nothing present in large amounts except calcium and magnesium bicarbonate. It contains 12 to 14 p.p.m. of SO_4, about 5 p.p.m. of chloride, and a very low amount of iron. The addition of an equal or greater amount of sulfate or chloride to distilled water with added alkalinity did not improve the coagulation. Finally about the only thing likely to be present in the water which had not been tried was silica in the form of colloidal SiO_2 or silicates.

Silica Used.—When it was decided to try siliceous compounds, a search of the laboratory revealed that the only silica compound on hand was a small amount of sodium silicate which was several years old. As the bottle had not been stoppered tightly much of the water had evaporated and the material was no longer a liquid. Some of the alkali in the upper part of the bottle no doubt had been carbonated. Adding a little water to the bottle and breaking up some of the solid in the upper part of the bottle with a spatula, part of the silicate went into solution. A small amount of this solution added to water gave improvement in coagulation with aluminum sulfate. This solution, after standing a few days, not only did not improve coagulation but seemed to retard it. Probably the concentration of soluble silica increased, for a considerable amount of the broken-up particles of the solid sodium silicate was transferred with the solution to the flask in which it was held. Another solution from this old material prepared from some of the material lower down in the bottle gave only slight aid to coagulation.

New sodium silicate was purchased, and when diluted and added to water, it retarded instead of giving aid to coagulation. Then it was thought that the first material must have contained some impurity which aided the coagulation, but efforts to find the impurity were without success. A study of the data obtained up to this time did not look promising, yet there was the fact that one solution containing soluble silica had given aid to coagulation and this gave encouragement to continue the search. Then it was decided to see if some certain form of the silica produced the beneficial results. Remembering that the alkali of the sodium silicate in the upper part of the bottle of old material could have been largely carbonated, the first thought was to carbonate a weak solution of the fresh sodium silicate. A solution containing about 290 p.p.m. of SiO_2 was prepared and carbonated, leaving it distinctly alkaline to phenolphthalein. The addition of 3 to 5 p.p.m. of SiO_2 from this solution greatly aided coagulation. Definite proof that silicon in some form aids coagulation then was established.

Experiments Using Silicon to Aid Coagulation

At the time of this writing the subject has not been fully investigated, and it is not possible to state the extent of the aid which may be given to the coagulation of natural waters by the use of compounds of silicon. The few tests so far made on Lake Michigan water, sewage, and certain industrial wastes, indicates that the rate of coagulation is greatly increased by its use. The fact which has been definitely established is that a small amount of silicon in some form greatly aids in the coagulation of solutions prepared from distilled water. This offers an explanation of the difference between results obtained with such solutions and natural waters, for all natural waters contain at least a small amount of

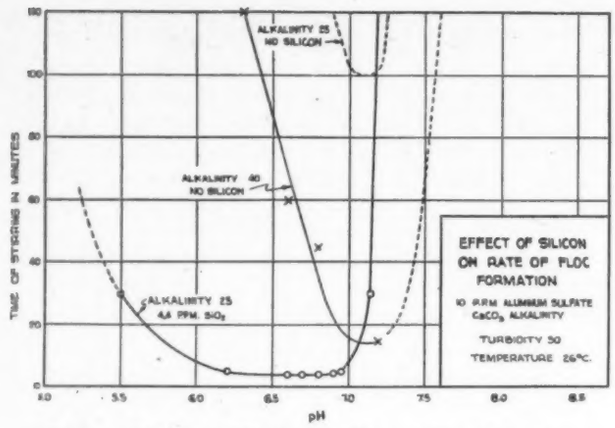


Fig. 1.—Effect of Silicates on Rate of Floc Formation.

silica in solution. The first few solutions of silica which were used for the addition of this substance to water were prepared by carbonating weak solutions of sodium silicate. Other acids were later tried and seem to produce the same results.

Effect of Varying the pH.—Table 2 shows the effect of varying the pH with carbon dioxide when 10 p.p.m. of aluminum sulfate are added to solutions free or nearly free from silica and containing 40 p.p.m. of calcium carbonate. The most rapid floc formation was found to be at pH of 7.0 to 7.2, and the time required to produce excellent coagulation increased rapidly when the pH was increased or decreased from these figures. This is shown more clearly by one of the curves in Figure 1. The broken part of the line indicates that the position of the line has not been established definitely. Tests were made on alkalinities of 20 and 30, so the broken line for alkalinity of 25 was taken at about half way between the two lines. With alkalinity of 25, the time of stirring required to produce excellent coagulation at the optimum pH was approximately 100 minutes, but when 4.4 p.p.m. of SiO_2 from a carbonated solution of sodium silicate were added the time of forming an excellent coagulation was lessened greatly over a pH range of 6.0 to 7.0. This is shown in Table 3 and by one of the curves in Figure 1. All of the curves in Figure 1 are based upon the time of stirring required to produce excellent coagulation.

The proportion of the silica in the solution which existed in the form that aids coagulation is not known, and it would be an accident if the solution contained the maximum which could be produced by any treatment of the silicate. The total SiO_2 added to the water to be coagulated was only 4.4 p.p.m. This probably explains why there is a much wider pH range of good coagulation in most natural waters than is obtained from solutions prepared by the addition of alkalies to distilled water. It also indicates the possibility that the use of silica compounds in some waters will be economical, for it would be an unusual coincidence if all natural waters contained the right amount of silica to produce the best coagulation.

Effect of Varying the Silica Concentration.—Strange results have been obtained by varying the silica concentration in the water. Some of the solutions which have been prepared produce effects different from others. This, very likely, is because there is only a partial conversion of the silicon compound to the form which aids coagulation, and the best treatment to produce the maximum amount of this form has not been determined. Tables 4 and 5 give results obtained with two silicate solutions. Curves for the time of stirring to produce an excellent coagulation are shown in Figure 2. The rapid jump from great aid to coagulation with solution No. 2 to no aid, as the concentration is increased above

TABLE 1.—EFFECT OF DILUTING LAKE MICHIGAN WATER WITH DISTILLED WATER ON TIME REQUIRED TO FORM COAGULATION.

Calcium carbonate added to give alkalinity of about 22. 10 p.p.m. Aluminum sulfate. Turbidity 30. 29° C.
(The Lake Michigan water contained an alkalinity of about 120 before dilution, and was filtered through paper.)

Test No.	$CaCO_3$ Added P.P.M.	Per Cent Lake Water	pH 5 Min.	pH 30 Min.	pH 90 Min.	Alkalinity at End of Test	Turbidity after Filtering
1	20	0.0	6.5	6.6	6.7	19	0.1
2	15	4.2	6.4	6.6	6.7	18	0.0
3	10	8.3	6.4	6.6	..	18	0.1
4	5	12.5	6.4	6.5	..	17	0.0
5	0	16.7	6.4	6.4	..	18	0.1
6	0	100.	6.6	..	..	117	0.0

Test No.	Minutes Stirring Required to Form Coagulation—Just Visible	Small Particles	Fairly Good	Good	Excellent
1	50	120	..	..	..
2	25	40	60	120	..
3	12.5	20	25	30	40
4	10	12.5	15	20	25
5	6	7.5	9	10	12.5
6	4	5	6	7.5	10

TABLE 2.—EFFECT OF VARYING THE pH WITH CO_2 ON TIME REQUIRED TO FORM COAGULATION.

Calcium carbonate alkalinity of 40 prepared from distilled water. 10 p.p.m. Aluminum sulfate. Turbidity 30. 26° C.

CO_2 P.P.M.	pH 5 Min.	pH 30 Min.	Minutes Stirring Required to Form Coagulation—Just Visible	Small Particles	Fairly Good	Good	Excellent
54	5.8	6.0	120	..	..	..	..
22	6.3	6.3	60	75	90	105	120
11	6.6	6.6	30	35	40	45	60
5	6.8	6.8	20	23	27	30	45
1	7.2	7.2	5	7.5	10	12	15
0	7.9	7.9	45	(No change after stirring 2 hours)			

TABLE 3.—EFFECT OF VARYING THE pH IN WATER TREATED WITH SILICATE AND ALUMINUM SULFATE ON TIME REQUIRED TO FORM COAGULATION.

4.4 p.p.m. SiO_2. Turbidity 30. Temperature 26° C.
10 p.p.m. Aluminum sulfate.

Test No.	pH 5 Min.	pH 30 Min.	pH 90 Min.	P.P.M. $CaCO_3$ at End of Test	Turbidity After Filtering
1	5.5	5.6	..	22	0.0
2	6.2	..	..	22	0.0
3	6.6	..	..	22	0.0
4	6.7	..	..	21	0.0
5	6.8	..	..	22	0.0
6	6.9	..	..	22	0.0
7	7.0—	..	..	22	0.0
8	7.1+	7.1+	..	23	0.2
9	7.3	7.2	7.2	23	4.6
10	7.7	7.7	7.6	23	8.0

Test No.	Minutes Stirring Required to Form Coagulation—Just Visible	Small Particles	Fairly Good	Good	Excellent
1	20	22	25	27	30
2	3	3.5	4	4.5	5
3	3	3.2	3.5	3.7	4
4	3	3.2	3.5	3.7	4
5	3	3.2	3.5	3.7	4
6	3	3.2	3.5	3.8	4.1
7	3.5	3.9	4.2	4.6	5
8	15	17	19	25	30
9	50	60	90	(No further change)	
10	(No visible coagulation in 2 hours)				

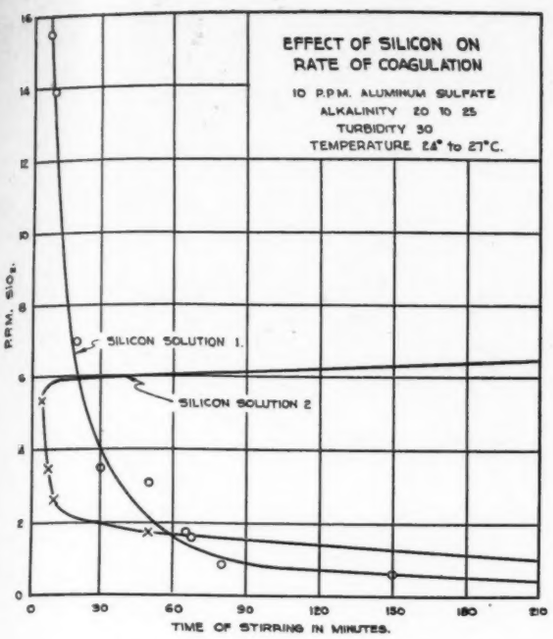


Fig. 2.—Effects of Silicates on Rate of Coagulation.

a certain point, is interesting. No explanation for this can be offered at the present time, unless the colloidal aluminum hydroxide particles become negatively charged by the adsorption of an appreciable amount of silicon in some form. There is the possibility of the production of a finely divided crystalline aluminum silicate.

It may be advisable to state that only solution No. 1 has shown the characteristics given, and that all of the others which gave good aid to coagulation in certain concentrations have shown characteristics somewhat similar to solution No. 2. Solution No. 1 was prepared from the old sodium silicate and No. 2 was prepared from sodium silicate recently purchased.

(The effect of silicon on the amount of coagulant required to produce coagulation of the water, and the characteristics of the flocculation produced, will be discussed in the next article.—The Author.)

TABLE 4.—EFFECT OF ADDING SILICATE TO WATER CONTAINING CALCIUM CARBONATE ON TIME REQUIRED TO FORM COAGULATION.

10 p.p.m. Aluminum sulfate. Turbidity 30. 27° C.
(Silica solution No. 1 used.)

Test No.	SiO_2 P.P.M.	pH 5 Min.	pH 30 Min.	pH 90 Min.	Alkalinity at End of Test	Turbidity After Filtering
1	.00	6.6	6.6	6.8	19	0.2
2	.87	6.6	6.6	6.8	19	0.0
3	1.74	6.6	6.6	6.8	18	0.0
4	3.48	6.6	6.6	..	19	0.0
5	7.0	6.5	6.6	..	17	0.0
6	13.9	6.9	..	..	18	0.0
7	13.9	5.8	6.0	..	19	0.0

Test No.	Minutes Stirring Required to Form Coagulation: Just Visible	Small Particles	Fairly Good	Good	Excellent
1	90	165	..	..	..
2	50	60	68	75	80
3	35	40	50	60	70
4	20	22	24	26	30
5	10	12.5	14	15	20
6	4	5	6	7.5	9
7	20	26	30	35	40

TABLE 5.—EFFECT OF VARYING THE AMOUNT OF SILICATE ON THE TIME REQUIRED TO FORM COAGULATION.

10 p.p.m. Alumuinum sulfate. Turbidity 30. 25° C.
Silica added in the form of carbonated sodium silicate.
(Silica solution No. 2.)

Test No.	$CaCO_3$ P.P.M.	SiO_2 P.P.M.	pH 5 Min.	pH 30 Min.	pH 90 Min.	Alkalinity at End of Test	Turbidity After Filtering
1	20	0.0	6.5	6.6	6.8	19	0.2
2	20	1.8	6.4	6.5	..	18	0.0
3	20	2.7	6.4	..	..	20	0.0
4	15	3.6	6.3	..	..	15	0.0
5	12	5.4	6.3	..	..	16	0.0
6	12	7.2	6.4	6.4	6.7	16	5.0
7	10	9.0	6.3	6.4	6.8	16	10.0
8	0	19.0	6.2	6.4	6.8	10	25.0

Test No.	Minutes Stirring Required to Form Coagulation: Just Visible	Small Particles	Fairly Good	Good	Excellent
1	75	(No further change after stirring 3 hours)			
2	20	25	30	40	50
3	5	6	7.5	9	10
4	3	4	5	6	7.5
5	2	2.5	3	3.5	4
6	60	150	..	..	..
7	(No visible coagulation after stirring 2.5 hours)				
8	(No visible coagulation after stirring 3 hours)				

Georgia's Fifth Water and Sewage Works Operators' Short School Marked Success

Georgia held its 5th Annual Short School for Water and Sewage Works Operators November 4-6th, inclusive, at Georgia Tech. in Atlanta. The school is sponsored by the Georgia Water and Sewage Operators Association, Georgia Tech., and Georgia Department ot Health.

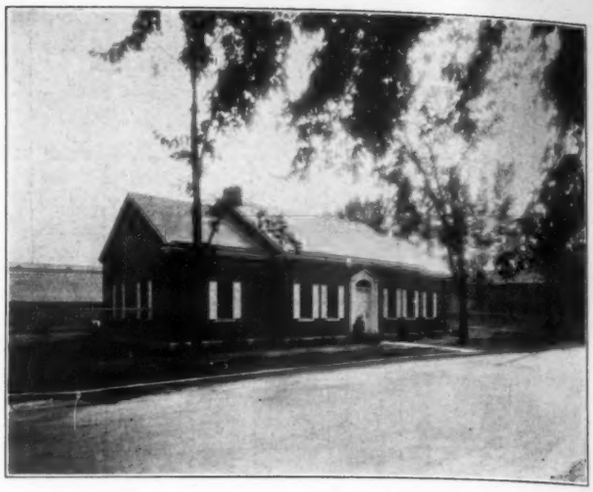
For the recent school, 186 "students" registered. Of this number 125 were superintendents, chemists or operators of plants—representing a phenomenal growth of the school in the five years of its existence.

A worthy feature was that of following lectures and laboratory work with working demonstrations at the new water and sewage treatment works of nearby Griffin, Ga., under H. P. Powell, Superintendent of Water and Sewage and Lewis Simonton, Chemist in Charge of Plants. Here also, selected manufacturers' representatives had been invited to describe the care and operation of the more important units of equipment in modern water and sewage plants.

Interesting, likewise, was the eagerness with which sophomores and juniors of the 1935 school returned in 1936 to take examinations, looking to the next higher grade of "Certification" by receiving certificates as a Class "A" or "B" operators, as the case might be in stepping up from Class "B" or "C."

The marked interest by Georgia operators in the Short School and the Operator Certification plan has been due to the work of the two (no relation) Weirs—"Bill" Weir, of the Georgia Dept. of Health, and Paul Weir, Chemist of the Atlanta Water Department, who is Secretary-Treasurer of the Georgia Operators Association, and also the Short School.

As president of the school, was elected Carl Alexander, of Rome, Ga.; as vice president, Lewis de Jarnette, of Atlanta, Ga.



Geneva's Attractive New Treatment Works (Pump Station, Laboratory and Chlorinating Building).

This report scheduled for our last issue had, unfortunately, to be held over for this issue. To officials and members of N.Y.S.S.W.A. (especially the president), we offer our apologies and print it, delayed.

WORLD'S LARGEST SEWAGE ASS'N MEETS IN GENEVA, N. Y.

A REPORT BY HARRY A. FABER, Associate Editor*

IN the rolling Finger Lake country the New York State Sewage Works Association held its fall meeting, October 9 and 10, at Geneva, N. Y., with a registered attendance of 165. L. H. Enslow, president, and Charles C. Agar, vice-president, presided at the sessions.

Proud were members to learn from Secretary Bedell that on January 1, 1936, members numbered 334 and that this figure had since been increased by a round 100 to 434. In addition, there were 20 associate members, making the grand total 454 members.

After a program offering a variety of technical papers and discussion, members visited the city's New Gulvin Park plant now in operation. This attractively designed plant features mechanically cleaned screens, primary sedimentation, pre- and post-chlorination, separate sludge digestion in heated tanks, and glass covered sludge drying beds. Designed for an ultimate 3.38 m.g.d. capacity, it has two hours detention, 3.0 cu. ft. per capita sludge digestion capacity, and 0.5 sq. ft. per capita sludge bed area—some of which for the present is devoted to growing prize pumpkins—see picture.

Following the regular sessions, trips were offered to the Newark activated sludge plant, or to the Auburn chemical treatment and sludge incineration plant, now under construction.

*Assistant Engineer, The Chlorine Institute, New York City.

A. S. Bedell, Secy. Albany, N. Y. Proud of the Growth of N. Y. S. S. W. A.

Larry Luther, Freeport, L. I. Responsible for the 77 Members Long Island Branch.

Gadget Contest

An innovation for this meeting, which received approbation, was the exhibit of original sewage plant "gadgets."

R. C. Sweeny, chairman of the award committee, announced that balloting by members had given first prize to the ingenious and workmanlike sludge grinder exhibited by the city of Ithaca. Admittedly a large "gadget," this required its own truck for transportation and was exhibited outside the municipal building. Contrasting considerably in size, a laboratory centrifuge, cleverly adapting a small electric motor to the purpose, took the second prize to Rockville Center, L. I. An automatic air relief valve, constructed from stock pieces, was awarded third prize. This, too, went to Ithaca.

At the association luncheon the president lauded the prowess of the Long Island Branch and introduced several sewerage commissioners present. Mayor Henry T. Maxwell welcomed members to his city and spoke with pardonable pride of the modern sewage treatment plant Geneva had built to prevent pollution of Seneca Lake. This was constructed with a PWA loan and grant of $305,000.

Entertainment

In its evening session the informal dinner was followed by entertainment supplied by the local committee and drawn from the Hobart College glee club and a local dancing school. Dancing followed. Ladies were entertained with a special luncheon at the Geneva Country Club, and were offered auto trips to nearby colleges or to the State Agricultural Experiment Station, as well as opportunities for bridge and golf.

Crowding the meeting room to capacity, the famous "Sunrise Breakfast," followed by the Question Box Round-Table discussion, again proved to be a feature of the program. Topics discussed are covered at the end of this report.

Our Hosts

Geneva's Mayor—Henry T. Maxwell; Chamber of Commerce's Leo A. Taylor; Geneva's Director of Works—J. W. Brennan. (We Learned Why Geneva Likes Them.)

Technical Sessions

(L. H. Enslow and C. C. Agar, Presiding.)

"Experiences with Activated Carbon in Sewage Treatment," WILLIAM A. RYAN, Sanitary Chemist, Rochester, N. Y.

Mr. Ryan cited the use of activated carbon as an example of the wider use of chemicals in sewage treatment. To illustrate the purpose it serves, he described its application at several New York State plants under his direction.

At Newark, the gas generated contains an abnormal amount of hydrogen sulfide. As it is used for power in gas engines, activated carbon is applied to the raw sewage to adsorb and partially prevent the formation of H_2S. While some of the carbon settles in the primary tanks, some carries through the aerator to the final tanks. Digester gas is reported free of odors.

At East Rochester, 75 per cent of the carbon added to the raw sewage is removed in the primary tanks (Imhoff) and the remainder goes to the sprinkling filter. An increase in gas volume was reported. Fairport uses carbon to prevent septicity of sludge in the secondary settling tank. Added to the sprinkling filter effluent, the sludge is kept down for five weeks, and so lengthens the interval between cleanings. In the winter of 1935-36, temperature becoming low in the separate sludge digester, carbon was added to the discharge side of the sludge circulating pump. A temperature rise from 35 to 54 degrees was reported. It was necessary to use lime with the carbon to maintain a pH of 7.0.

The Brighton (Imhoff) plant received considerable industrial waste, and odor complaints were numerous, but adding three tons of activated carbon and seven tons of lime in the last six months had ended the complaints. Albion and Hamburg plants had also used carbon successfully for odor control.

Summarizing, Mr. Ryan said activated carbon serves to adsorb odors, H_2S, and hold down sludge. It does not disinfect; replaces no chlorine or bleach. By absorbing CO_2 and grease, it tends to raise the pH.

In the discussion, E. A. STERNS, Hamburg, said prechlorination for sterilization and odor control is practiced at his plant, but that carbon added in a 3 p.p.m. dose prevents odors from open tanks.

PROF. C. L. WALKER, Cornell University, reported on controlled experiments at the Ithaca plant over an 18 month period. Carbon was added to the sludge in the pump well and sent to the digester. This so discolored the returned supernatant that it was difficult to tell when all the sludge was drawn. Studying gas production at different temperatures, in 55 gallon digesters, he noted a slight increase at 20 deg. but none at 28 or 45 degrees. There was, in fact, some evidence that at higher temperatures operation was better without carbon. Analyses of the gas revealed the main difference to be that practically no H_2S was present when carbon was added to the sludge.

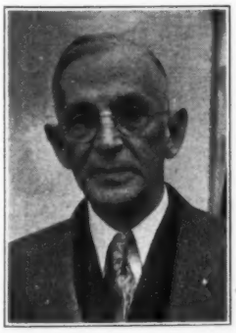
"Problem in Sewage Treatment at State Institutions," CHARLES W. MCBREEN, Chief Engineer, Rockland State Hospital, Orangeburg, N. Y.

At the Rockland plant, Imhoff tanks, sprinkling filters, and secondary tanks comprise the treatment for sewage from one of the largest state hospitals. Present population is 5,000 and this will be increased to 9,000 by next July. Unusual was the large grease content; also, the recovery each week of 150 to 200 pieces of laundry from the bar screens. A small growth extending to a depth of 2 feet in the sprinkling filters is believed to prevent ponding. Trouble had been experienced through sludge becoming septic and rising in the secondary tanks. This had lately been prevented with prechlorination; and, with it, the odor problem had been eliminated. Postchlorination (applied to filter discharge) produces a residual of 0.1 to 0.2 p.p.m. at the secondary tank outfall, and maintains a satisfactory effluent. The large amount of laundry and grease waste necessitates frequent skimming, but obviates the necessity for adding lime. Screenings now are added to the Imhoff digestion compartment and the addition of a mechanical screen and screenings grinder is planned.

Proud of Geneva's Plant

T. R. Kiddick, Chemist, Chas. F. Jost and Geo. H. Buck, Engineers with the Late Nicholas S. Hill, Jr. Responsible for Design and Operation of Geneva's Treatment Plant

HENRY RYON, Senior San. Engr., State Department of Public Works, discussed the paper. He stated that high per capita flows, typical of institutions, require unusual plant design. The maximum of 295 gal. per capita (170 avg.) at state hospitals compares with 100 gal. at a prison. Such considerations as peak pumping rates (4



John R. Woodford, No. 1. Gadgeteer (Started as Inspector; Retires as Superintendent After 40 Years in Ithaca's Sewer Department).

Harry W. Eustance, City Engineer, Ithaca, N. Y. (Member Exec. Board.)

Stanley T. Barker, Asst. Engr., N. Y. State Dept. of Health.

Wm. E. Stanley, Prof. Sanitary Engineering, Cornell Univ.

times the average), and night flows of but 15 per cent of the average must be considered. Temperature of such sewage averages 75 deg. F. and some reaches 95 deg. F. This prevents grease congealing in the grease traps and sludge floats as a result.

Protective Coatings

"Protection of Sewer Pipe and Concrete," M. F. ABRAMS, Wailes Dove-Hermiston Corp., New York City.

Increasing the life of both pipe and concrete structures by proper use of the special paints and coatings developed for this specific purpose was the topic developed by Mr. Abrams. Many examples were cited in which the condition to be corrected determines the type of coating to be applied. A coal tar base paint was declared better than asphalt, since the latter softens and will not stay in place. In the painting of concrete, he stressed particularly that the extent of penetration is more a property of the concrete than of the paint. If a paint of large covering capacity be used the coating will be too thin to be effective. A paint sufficiently thin for spray application does not have enough body and thickness to be resistant to acid attack. Concrete cannot be made impervious to hydrogen sulfide, chlorine, or abrasives unless many coats are applied. A thick-bodied paint is preferable, and such coats have held up for eight years in an Atlantic City sewer. While hot applications are best, at Elizabeth coal-tar paint has been held on both concrete and steel—below sewage level—for three years. He recommended two coats of hot bituminous paint on iron and steel with two final coats of aluminum for appearance.

To resist dry-rot of wood and infiltration into Imhoff tanks, a plastic bituminous paint which does not crack or check is most tenacious. Unless punctures of the surface are large, they will be self-healing. Most important is that the air temperature be above 40 degrees and that the surface be moisture-free when paint is applied, so that steam will not be generated. Grease or oil must be removed, and the surface is best prepared by wire brushing.

ROBERT C. WHEELER, Consulting Engr., Albany, N. Y., in opening the discussion said that he believed his ten years of experience in the protection of concrete with such paints insufficient to be conclusive. The most universal difficulty he claimed to be caused by application on wet concrete. In answer to a question by Mr. Enslow, Mr. Abrams said green concrete should stand at least a week before applying paint, and in difficult cases the best method is to apply a small patch and see if it blisters. He cited the use at Glasgow, Scotland, of tanks on sludge barges. These tanks, with a bitumastic lining, have been used since 1903 with the lining still intact.

J. H. FEIGEL, Asst. City Engr., Buffalo, remarked that cast iron pipe coated both exterior and interior is in excellent preservation after 48 years in his city. Mr. Otto of the Caustine Chemical Toilet Company said enamel has been in use coating such tanks. He stressed the importance of perfect coating, saying that a pin-hole is as bad as a rat-hole.

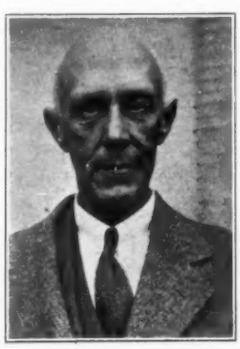
"Control of Sewage Plant Odors," G. W. MOORE, District Sanitary Engineer, State Health Department, Rochester, N. Y.

Mr. Moore, stressing the psychological effect of sewage plant odors, described in particular one Imhoff plant where slow sand filters are employed for final treatment. Septic solids accumulate during week-end low flows and on Monday morning are flushed into the plant. A chlorine dose of about 12 p.p.m. was required to give 1.5 p.p.m. residual. Unless this was applied, late afternoon odors were prevalent, despite the fact that no H_2S was present. The use of chlorine is justified, he believes, for the control of odors which can be controlled by no other method. In addition, design of a settling compartment need not be planned for so high a future capacity when chlorination is available.

VICTOR HAEMMERLINE, City Engr., East Aurora, N. Y., described an experience at his Imhoff-trickling filter plant in the control of odors. Chlorinated-iron was prepared in a tower using scrap from a metal stamping works and treating with chlorine water from a vacuum chlorinator. About 26 lb. per day of chlorine was used in such a fashion, and about 18 lb. per day was applied directly to the sewage. In the early part of the summer this proved very effective in controlling odors by reacting with the hydrogen sulfide present. In July and August, however, low flows were insufficient to move solids in the sewer, and they became septic with the production of more H_2S than could be taken by the limited amount of chlorinated iron available.

CHARLES C. AGAR, saying that gas from Imhoff vents may be the only cause of odors from some plants, noted that East Aurora has a bad scum problem. He suggested that the use of chlorinated iron on the scum in gas vents might be of value. L. H. ENSLOW pointed out that all of the chlorine applied should have been converted to ferrous chloride as the most efficient and economical odor corrective. Citing Princeton, N. J., as requiring so heavy a chlorine dose that by-product (medicated) odors were produced as a result, he said this had been corrected by the use of the indirect chlorination through the chlorinated iron process. While the septic sulfide odors could be controlled, not all sewage plant "smells" could be.

MORRIS COHN, Schenectady, said that in his experience with odor control there was no necessity for a



Wm. C. Hamm, Supt. Sewers, Port Washington, L. I. (New York's Senior Operator.)

Ernie Larsen, Operator, Geneva, N. Y. (Has a Nice New Plant.)

H. B. Diehl, Reeves Pulley Co., New York City; Gil M. Smith, Chicago Pump Co., Chicago; Bill Fenger, Mathieson Alkali, Hamburg.

chlorine residual, but that septic sewage odors could be prevented more effectively and economically than "cured." To this end heavy chlorine dosing had not been necessary to hold odors to those of flesh or reasonably fresh sewage. Humidity and many other conditions, such as movement of air currents, affected the spread of odors. He had propounded the basis for odor control some years ago as "The Three C's of Odor Control"—1st, Cleanliness; 2nd, Care; 3rd, Chlorine, when required. He still believed it to be sound.

"Water Supply and Sewerage at Geneva, N. Y.," J. W. BRENNAN, Supt. of Public Works, Geneva, N. Y.

This city had the first water supply to be incorporated (1803) in the state of New York. Spring-fed ponds supplied water through wood pipes. Since 1912 the supply has been pumped from Seneca Lake, filtered through slow sand filters, chlorinated, and stored in covered concrete reservoirs. Average consumption was 2 m.g.d. and the revenue of the city-owned Water Department had been sufficient to supply a reserve of $115,000.

Because of abundant dilution available, discharge of untreated sewage into Seneca Lake was long practiced. Now, with increased population, treatment had become necessary and the new plant was put into service in December, 1935. A 30 inch outfall carries the treated effluent 1,050 ft. from shore. The topography of the land makes another plant necessary. This plant, south of the city, will treat only 10 per cent of the total flow when it goes into operation.

"Operation of the Geneva Sewage Treatment Plant," E. A. MARSHALL, Superintendent, Geneva.

Mr. Marshall described the plant equipment which makes for practically "automatic" operating procedure. A mechanical screen is followed by a Venturi meter which operates two automatic W & T chlorinators, for pre- and post-chlorination. The sewage has an average summer chlorine demand of 16 p.p.m., which may be increased to as much as 43 p.p.m. when beet canning wastes are received. This large dose bleaches the pink waste color, thus serving as a check for adequate residual. Bacterial results all show 24 hour B. coli tests to be negative. B O O reduction from settling and chlorination exceeds 40 per cent and an average of 0.7 cu. ft. of gas per capita is being produced. Gas is used for heat and for power to pump sludge. Digested sludge dries in the glass-enclosed beds in 15 to 20 days, and is easily pulverized and disposed of for use as a lawn fertilizer.

Sunrise Breakfast and Question Box

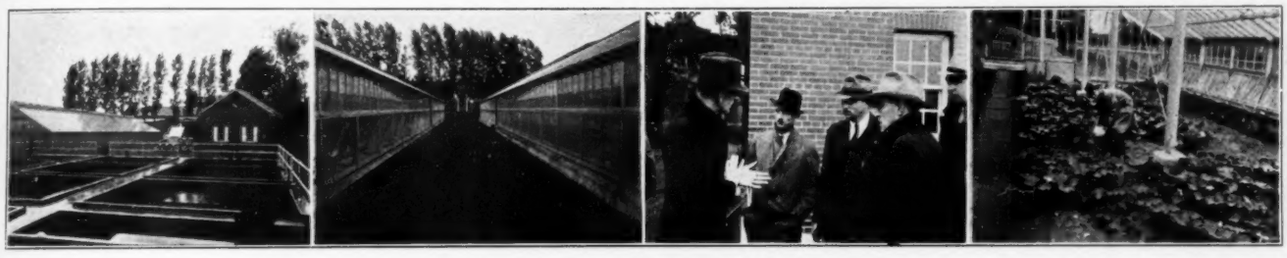
(Linn H. Enslow, Presiding.)

Under Messrs. Agar and Cohn the round table discussion proved a valuable and all-too-brief part of the program. Time permitted answering less than half of the worth-while questions propounded by members.

Some of the questions of seemingly greatest interest and answers thereto follow:

Q. *Regarding the use of scrap iron for odor control, as described at East Aurora, will someone give more details as to the method employed—turning scrap iron or tin cans to iron chloride?*

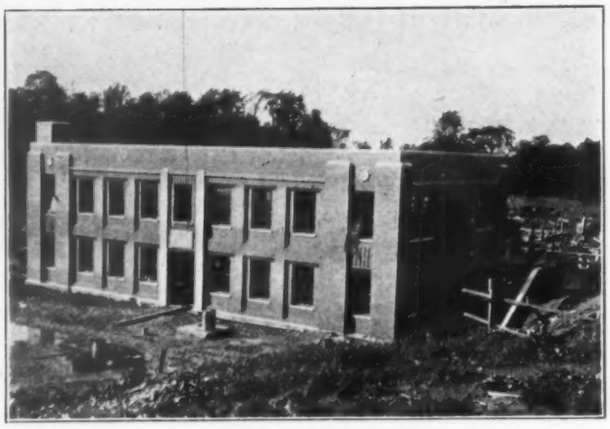
A. (H. A. FABER, The Chlorine Institute, Inc.) This method of preventing hydrogen sulphide odors is coming into increasing use because of its economy and simplicity. The type of tower used must be resistant to corrosion. Tile pipes, two or three feet high, joined with acid-proof cement are often used, and a rich cement concrete tower is sometimes built. At East Aurora a rather unusual one is in use made of a heavy wood tank set upright down in a manhole. It is coated thickly with paraffin for protection of the inner surface. In any type of tower, the chlorine water from a chlorinator is discharged at the bottom of the tower, flows upward in contact with scrap iron turnings, stampings or crushed tin cans. The ferrous chloride solution, so produced, flows from the top of the tower into the sewage. Control is simple, as ordinarily the dose may be either fixed or changed only twice daily. The dose required may be easily determined by analysis of sewage for sulphides because each part of chlorine passing through the tower leaves as ferrous chloride. In this form every 2 parts of chlorine will take care of one part of hydrogen sulphide, whether it be present at the point of treatment



At the Geneva Plant—in the Rain

Settling Tanks; Looking at a Digester Beyond the Sludge Beds; E. A. Marshall, Supt. of the Plant (Left) Shows It with Justified Pride, While Somebody Is Stealing One of His Pet Sludge-Fed Pumpkins.

F. M. Thompson, Asst. Engr., State Dept. of Health; Ralph Sweeney, Asst. Engr., State Dept. of Health (Had Charge of Gadget Contest); John H. Feigel, Sewerage Engr., Buffalo, N. Y.



Auburn's Chemical Treatment—Sludge Incineration Plant Nearing Completion.

or be produced later on in the system. The method is economical because chlorine used alone reacts with organic matter as well as with the sulphides, whereas the ferrous chloride reacts only with the sulphides. Non-volatile iron sulphide is thus produced from the odor-producing substance on the most economical known basis. Further, there is no hazard from possible over-chlorinization at night.

Q. *Can the screenings from a 5/8-inch bar screen be disposed of in a digestion tank?*

A. (L. LUTHER, Supt., Freeport, N. Y.) At Freeport screenings were first used in a digestion tank and caused no difficulty—perhaps because stirring was carried out. Now these screenings are shredded and returned to the inflowing sewage. They cause no trouble from floating.

(CHAS. AGAR, N. Y. State Health Dept.) North Adams, Mass., where screenings are being added to digesters, is having trouble with scum formation. Scum has been encountered 12-15 feet deep in the digestion tanks. The construction of the digesters is being changed in an attempt to remedy this. Provision for stirring or recirculation is to be provided.

Q. *What are important safety measures required at sewage plants?*

A. (W. W. WATKINS, Supt., Oneonta, N. Y.) At the Oneonta plant the digesters are conspicuously posted to warn against fire hazard. There are two open flames beneath the gas boilers, but no other "loose" gas or open flame is allowed.

(HARRY EUSTACE, City Engr., Ithaca, N. Y. Whenever the level in the digestion tank is drawn down especial precautions are taken to prevent air from entering the digester. A safety lamp is used when tanks or pumps are entered, and these are first well aired.

(L. H. ENSLOW, President of the Association.) In his opinion at a properly engineered plant, warning signs are not essential. In the spot of greatest danger there is always the open flame under the boilers. At Bristol, R. I., the explosion due to escaping gas was chargeable to deficient design. It is both wise and more economical to pay for reliable danger-proof equipment in gas handling and the adoption of proper precautions than for the results of an explosion. That had been thoroughly proven.

(CHAS. C. AGAR, N. Y. State Health Dept.) Disagreeing with the president, believes signs are of real value to warn operators and visitors. There may be leaks through the gas meter, through the superstructure over the digestion tank, or where the flame is vented through the stack. The use of signs seems desirable in addition to safe design and precaution in operation.

Q. *If the pH changes from 6.0 to 7.0 does it go up or down?*

A. (E. B. PHELPS, Prof., Columbia Univ.) Said he realized the confusion that exists in the use of the term and explained how it was that as the number goes up the hydrogen ion concentration (acidity) goes down.

Q. *What is the best lime to use—pebbled unslaked lime, commercial hydrated lime, or agricultural lime—for the adjustment of digester pH?*

A. (F. A. CARY, Supt., Fairport, N. Y.) At Fairport hydrated lime mixed with hot water has been found best.

(FRANK HOLLAND, Commissioner, Freeport, N. Y.) The difference in limes is only a practical one. "Masons" lime is one containing 40 to 60 per cent magnesium. Other limes are 90 to 94 per cent calcium oxide and only a trace of magnesium. Lime is hydrated to remove the heat of reaction, and leaves the same constituents but in a more "diluted" form.

(CHAS. C. AGAR) Agricultural lime, or ground limestone ($CaCO_3$), is not satisfactory for use in a digester, as this is too slowly soluble. Hydrated or "plasterer's lime" is easiest to use. Whether it has a high calcium or magnesium content is not important as long as it will neutralize acidity. A high magnesium lime works satisfactorily. The pebbled or unslaked lime is merely a more concentrated form of acid correcting material. When water is added in slaking the hydrate is formed. A high-grade hydrated lime or pebbled lime should be specified; the first is easiest to use, the second generates much heat during slaking.

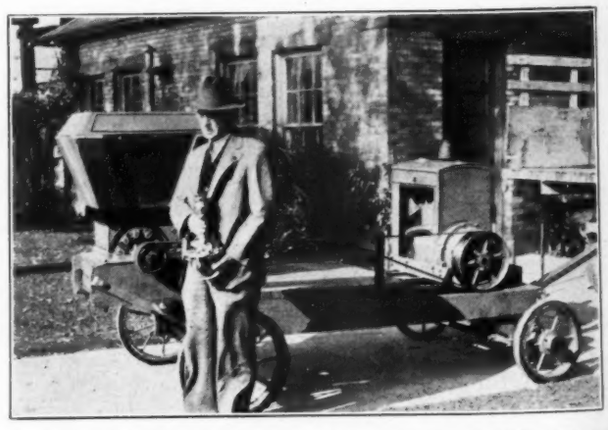
(WM. A. RYAN, Chemist, Rochester, N. Y.) The method of adding lime is more important than the amount—ordinarily too much at one time is added. In his experience, if several additions of small amounts of lime be added to sludge, less will be required than if one large amount is applied at less frequent intervals.

(J. E. FERRIS, Electro Bleaching Gas Co., New York City). At the new Coney Island plant hydrated lime is used because it will not increase the temperature while pebbled lime would.

(H. M. RATH, Senior Operator, Coney Island Plant.) Pebbled lime was first used at Coney Island but because of mechanical difficulties resulting in lower efficiency the hydrate is more successful. The lime is added to the suction line to the recirculating sludge pumps.

(CHAS. AGAR) Observations over a period of years have shown the best method of application to Imhoff

Prize Gadgets



John Woodford, Supt. Sewerage, Ithaca, N. Y., Exhibits His 1st Prize Portable Sludge-Grinder; Holds His 3rd Prize Automatic Air-Relief Valve.

tanks (at least from a practical point of view) is to add dry hydrated-lime to the gas vents. To add lime solution, or suspension, might be more efficient, but the additional labor and time of application is something to consider at most plants. By adding small daily increments and allowing it to dissolve slowly, by not hosing down immediately, this can be made efficient. If added to sludge, small daily amounts should be added as the sludge is pumped into the digester. It is important, if the digestion tank is already acid, to determine by batch samples the quantity of lime needed. Sixteen years experience has shown that with domestic sewage that hydrated lime, in amounts of five to ten pounds per day for each 1,000 population, will correct acid tank conditions for average sewage. However, more than a month of treatment may be required to bring this correction about. The best and most economical way is to prevent it from becoming acid and thus, by properly starting the digestion, no further lime additions need generally, be made after the digester has reached its balance between digested and new sludge input. This may, however, not hold true when institutional or industrial sewages are involved.

(R. D. SCOTT, Central Islip, State Institution, N. Y.) At his plant previously over 100 pounds a day were required but this has gradually been cut to about 50 pounds a day. The sewage is rich in grease and kitchen waste in general.

Q. *Can sedimentation be improved without the use of chemicals? Can pre-aeration help?*

A. (FRANK C. ROE, The Carborundum Co., Niagara Falls, N. Y.) The answer was, Yes. Aeration of sewage coagulates solids and gives some grease removal. Twenty to thirty minutes aeration will usually increase a 50-60 per cent suspended solids removal to 70 to 80 per cent. The B. O. D. reduction will in general parallel the suspended solids removal. If the usual removal is 35 per cent, this may be increased to 60 per cent by the use of air.

(WM. A. RYAN) At the Brighton, N. Y., plant, aeration within the flow chamber of Imhoffs actually added to the odor problem. It coagulates colloidal matter in the sewage but adds to the load on the trickling filter. With such aeration, activated carbon has been needed for odor control. The coagulated colloids do not settle well.

(L. H. ENSLOW) With reference to Mr. Ryan's comments on partial aeration: This cannot be successfully employed in the flow-through chamber of Imhoff tanks. Separation of the contents of digestion compartment and liquid above the slots is none too good at best in this type of tank, and upward currents caused by any air diffusion results in constant seeding with fresh sulphide producing organisms from below. Others have had Mr. Ryan's experience—even on Imhoff tank effluents. Now, by having a separate pre-aeration tank but no return sludge (and this is important)—the method may be used to some advantage, provided the air input is sufficient to keep the sewage from going septic.

(JOE GILBERT, Link Belt Co.) At Lakewood, N. J., there was secured an additional 20 per cent reduction in solids by merely using paddle mixing, at times when chemicals were not being added.

(L. H. ENSLOW) At San Francisco, a 30-minute mixing period in paddle equipped tanks had been found equivalent to a sizeable amount of chemicals. Such mixing was expected to be used continuously and chemicals held in readiness until necessary to secure additional purification by a more effective flocculation effect.

Q. *At Ithaca, N. Y., about once yearly the level of the contents in the sludge digester drops suddenly about 3 ft. The tank is apparently tight. How can this be accounted for?*

A. (W. W. WATKINS, Oneonta) At Oneonta, this happens when there is agitation or when drawing sludge. He believed it due to release of confined gas in the liquid, the sludge and the scum blanket.

(CHAS. AGAR) A conversation with Prof. Walker, Cornell University, Ithaca, brought out the fact that it is probably a scum problem, involving gas accumulations and releases.

(OGDEN KERR, Operator, Ithaca) Since sludge has been pumped at Ithaca twice daily their scum trouble had not been as great as previously.

Q. *What is the best method of disposing of the supernatant liquor from digesters?*

A. (F. C. ROE) This question came up at the last Ohio Conference. There, lagooning or disposal on sand beds seemed the most practical method for moderate and small sized plants.

(L. H. ENSLOW) The primary problem, at all plants, is to reduce this supernatant to a minimum volume, regardless of disposal method practiced. Some help is given by concentration of sludge prior to its digestion and the best operated plants concentrate the fresh input of sludge in some manner. This reduces the degree of "elutriation" through the digesters and thereby the loading on the treatment units. There is a toxic effect when supernatant is returned to raw sewage and the less of this the better. Applying it to sludge beds can be greatly improved by addition of chemicals for most effective dewatering, by floating the solids above the liquid. Lagooning is highly satisfactory if area is available and if plant location is suitable. The axiom should be: "Minimum liquid input to digesters to secure minimum digester disturbance and minimum supernatant problems"—also a better operating plant.

▼

Meetings Scheduled:

Dec. 29th—NEW YORK CITY, N. Y. (Hotel New York).
New York Section, A. W. W. A. (Mid-Winter Luncheon Meeting.) Sec'y.-Treas., R. K. Blanchard, 50 West 50th St., New York City.

Jan. 22-23—NEW YORK CITY, N. Y. (Hotel McAlpin).
New York State Sewage Works Association. Sec'y, A. S. Bedell, State Department of Health, Albany, New York. (On January 21st the Sanitary Engineering Division of A. S. C. E. holds its meeting, followed by the Annual Joint Dinner with N. Y. S. S. W. A. Attention is called to this new scheduling of the dinner and meeting the day following—Friday—and joint inspection trip on Saturday.)

February 15-20—COLLEGE STATION, TEXAS.
Texas Water Works Short School. Secretary, V. M. Ehlers, care Southwest Water Works Association, Austin, Texas.

March 25-26—(Location to be selected).
Four States Section A. W. W. A. Sec'y, C. A. Hechmer, Supt. Engr., Washington Suburban Sanitary District, Hyattsville, Md.

March 30-April 1—(Location to be selected).
Florida Section, A. W. W. A. Sec'y, J. R. Hoy, W. & T. Co., 404 Hildebrandt Bldg., Jacksonville, Fla.

April 6-8—(Location to be selected).
Southeastern Section, A. W. W. A. Sec'y, W. H. Weir, State Board of Health, 135 State Capitol Bldg., Atlanta, Ga.

April 14-16—MONTREAL, CANADA (Windsor Hotel).
Canadian Section, A W. W. A. Sec'y-Treas., A. E. Berry, Ontario Department of health, Parliament Buildings, Toronto, Ont.

June 7-11—BUFFALO, N. Y. (Hotel Statler).
American Water Works Association (Annual Convention). Executive-Secretary, Harry E. Jordan, 29 West 39th Street, New York City.

PRACTICAL ELECTRICITY IN THE PLANT

The A. B. C.'s of Electricity for Water and Sewage Works Man—Article No. 2 of a Series

By MARSDEN C. SMITH

Engr., Water and Electricity, Dept. Public Utilities
Richmond, Va.

IN A PREVIOUS ARTICLE were discussed the Volt, the Ampere, the Ohm and their practical meaning in operation and design. Before continuing, the reader should see Article No. 1 in WATER WORKS AND SEWERAGE for October, 1936.

The Watt

Another very important unit of electricity is the Watt, which is the unit of electrical power. The more commonly used unit is the Kilowatt, which is one thousand watts. The symbol for the Watt is (W); for the Kilowatt (KW). The mechanical unit of power is horse-power; one horse-power (H.P.) is the equivalent of 746 watts or 0.746 kilowatts. Due to the fact that the efficiency of small motors is approximately 75 per cent, the input in kilowatts is, by coincidence, closely the same as the mechanical output in horse-power.

With direct current, electrical power is the product of the current (I) and the voltage (E). Thus we have:

$$P = EI \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

However, substituting for (E) from equation (1), wherein $E = RI$, we have:

$$P = RI^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Or similarly, substituting for (I) where $II = \frac{E}{R}$ in the same equation:

$$P = \frac{E^2}{R} \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Now, it becomes evident that electrical power varies directly with both current and voltage, if resistance is not considered, but as the square of either (E or I) if the resistance is considered.

The Power Factor and Its Significance

With alternating currents equation (3) becomes the more familiar form, and—

$$P = EI \cos \theta \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

In this equation the Cos θ is designated as the power-factor. If an alternating current circuit contains resistance only (no capacity or inductance) the angle θ becomes zero; hence, its cosine, which is the power-factor becomes unity. Electrical installations in water and sewage treatment plants rarely contain sufficient capacity (condenser action) to be of any practical effect, hence we may omit further reference to "capacity" in these articles. Inductance, however, is of great importance, and in practical installations may reduce the power factor as much as 30 per cent.

The actual mathematical value of the power-factor of practical circuits is difficult to compute; however, it is well for the engineer to have some idea as to the values that may be expected. Incandescent lamps and heating devices, since they contain but little inductance, are virtually non-inductive; hence, their power-factor closely approaches unity. Motors and transformers vary through very wide limits. Of course, a transformer being highly inductive when delivering no load, its power-factor is quite near zero; but, at rated load the power-factor becomes quite nearly that of the circuit being supplied by the transformer. Small motors, up to 5 h.p. require power at not more than 60 per cent power-factor; particularly so when operating at light loads. Large induction motors, at full load, now may operate at as high as 94 per cent; and, synchronous motors, more fully discussed in coming articles, may be operated almost as desired.

The objection to low power-factors is that larger currents are required for the same power, thus increasing power losses in the whole electrical system. Furthermore, low power-factors cause much wider voltage variations than do greater loads with higher power-factors. For this reason many power companies offer reduced rates to those consumers whose apparatus constitutes a load having a favorable power-factor. This fact may be of value to many larger operators. It is true, however, that plant operators can exercise but limited control over the power-factor of their stations, except through the selection and operation of the motors. This phase of the subject will be later discussed when motors and their characteristics are considered.

The Kilowatt-Hour

The kilowatt-hour (KwHr) is the unit by which electric power is generally sold. As its name implies, it is the average power consumed, in kilowatts, multiplied by the number of hours involved. For example: if an electric iron is operated for two hours at average rating of 600 watts, there is used $600 \times 2 = 1200$ watt-hours, or 1.2 KwHrs.

The volt-ampere (VA) is the product of the volts and amperes of a circuit or an appliance, without reference to power. Thus, the transformer is always rated in kilo-volt-amperes (KVA) because its parts can be designed for the voltage and current value desired, but the power-factor of its load may vary through wide limits. Thus we see that:

$$KW = KVA \times \cos \theta \ldots\ldots\ldots\ldots (7)$$

Hence, if we are to know the safe load for a transformer rated at 100 KVA, we must first determine the power-factor of the load to be connected. If we may assume the load to be one-half lamps and one-half small motors; we may approximate the average power-factor to be 82 per cent. Hence, by equation (7) we find $Kw = 100 \times 0.82$ (82 Kw) to be the safe load for this case.

The Cos θ, which we now recognize to be the power-factor, is actually the cosine of the angle of time-phase displacement between the current and the voltage of an alternating current circuit containing "capacity" or inductance.

*See October, 1936, WATER WORKS AND SEWERAGE.

Phase-Circuits

The term, "phase," is also applied to designate the circuits of an alternating current system. In the "Single-Phase" system the *voltages* are in the same time-phase in all parts of the system. In the "Two-Phase" system, the two voltages are 90 degrees apart. In the "Three-Phase" system they are 120 degrees apart.

In another sense, there are in effect one or two or three circuits in the single, the two or the three-phase systems. Of course, the power-factor may be different in each phase; hence the currents in the phases may not be of exactly the same angular difference as the voltages producing these currents.

The simplest circuit is that comprising the single-phase (two-wire) system, as in Fig. 1. This is used for the final branch circuit of larger systems, and in case of small loads, including most residences, it is always used.

The single-phase, three-wire system is next in capacity and in frequency of use. Single-phase, two-wire branches are connected thereto as shown in Fig. 2. The evident advantage of three wires over the two-wire system is that when loads are balanced, the neutral carries no return current, hence the lamps and appliances operate at 120 volts, whereas the circuit operates at 240 volts. In this way twice as much power can be carried over the same wires, by merely adding one additional wire.

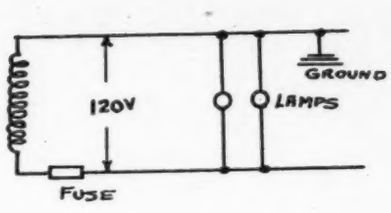


FIG 1

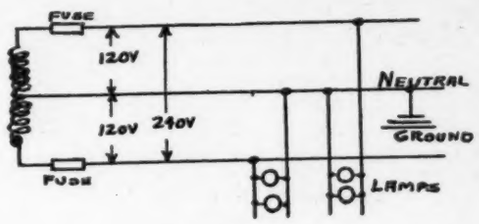


FIG 2

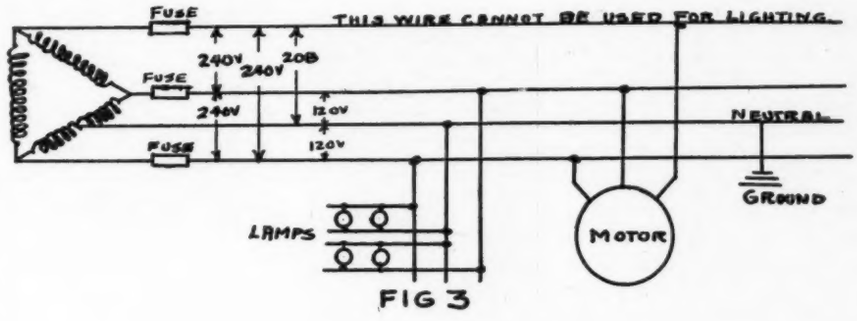


FIG 3

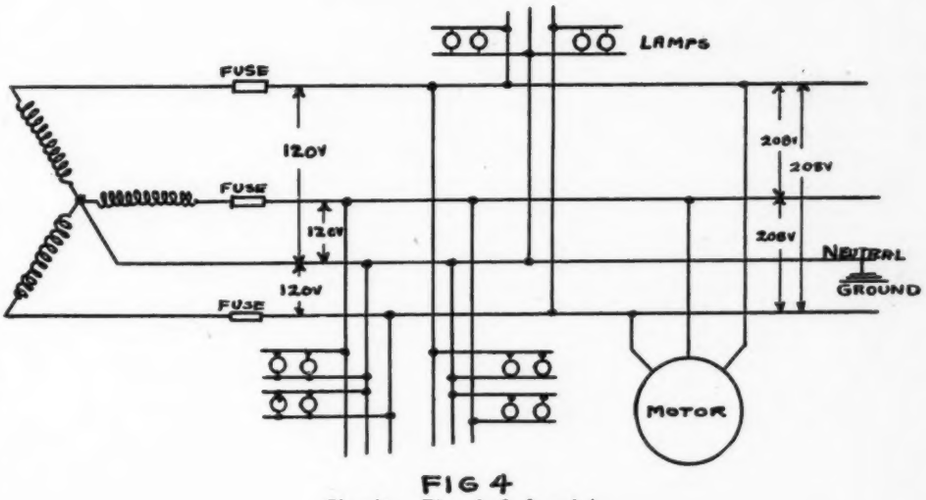


FIG 4

Circuits: Figs. 1, 2, 3 *and* 4

Grounding Practice†

The neutral must be grounded. It should be the same size as the phase wires; and, it must *not* be fused or connected to any switch, and the wire used for the neutral must have white covering for identification, and the neutral must be connected to the white screw in all receptacles. In the single-phase, two-wire system one of the wires must be grounded and the same rules as given for the neutral conductor wire must be observed.- Loads of less than 50 KVA containing only lamps and small motors, are served by this system.

Three-Phase Standard for Heavy Duty

The three-phase (three-wire) system is standard for motor loads. If lighting is required, the neutral of one transformer (made larger to carry the additional load) is brought out as in Fig. 3. Most power companies limit the single-phase load that may thus be supplied to 50 KVA. In addition, this method of supplying the lighting loads makes service interruptions more frequent because of the necessity for grounding one of the transformer windings. Perhaps most serious of all is the objectionable flicker in the lights obtained when starting motors, particularly elevators connected to the system. Of course, economy often rules and hence this system is frequently used; but unless the motors are relatively small, and are started very infrequently; it is undoubtedly better to separate the lighting and very small motors from the power system.

The three-phase (four-wire, Y connected) system is rapidly becoming popular for large installations in which the lighting load predominates, and yet some three-phase motors are needed. This connection is shown in Fig. 4. The only objection to this system is that no more than 220 volt motors can be used; and even these must operate considerably below standard voltage. This system is largely responsible for the trend to increase the lamp circuit voltages, as each five volt increase to the lamps results in an increase of 8.65 volts to the motors.

The formula for power in the different systems, with balanced load, is given in the following table.

†In coming articles, grounding practice as it effects water works piping will be given some discussion.

System	Power		Max. Volts to Ground
Single-Phase (Two-Wire)	$P = EI\cos\theta$	Here $E = 120$	120
Single-Phase (Three-Wire)	$P = EI\cos\theta$	Here $E = 240$	120
Two-Phase (Four-Wire)	$P = 2EI\cos\theta$	Here $E = 120$	120
Three-Phase (Delta)	$P = \sqrt{3}EI\cos\theta$	Here $E = 240$	207.8*
Three-Phase (Y)	$P = \sqrt{3}EI\cos\theta$	Here $E = 207.8$	120

*Volts to ground on lighting circuits is 120.

The two-phase (four-wire) system is so little used that no discussion is necessary.

Chas. A. Emerson Joins George B. Gascoigne

Chas. A. Emerson

Reorganized as G. B. Gascoigne & Associates, George B. Gascoigne, of Cleveland, Ohio, has recently announced the opening of Eastern consulting sanitary engineering offices in New York City, under the management of Charles A. Emerson, Jr. The New York office will be operated as an adjunct to and in cooperation with the 15-year-old Cleveland office of Mr. Gascoigne and associates.

George Gascoigne, a graduate of Ohio State University, was for a period of ten years in the employ of the city of Cleveland on the development of its sewerage and sewage treatment program. About fifteen years ago he established a consulting office in Cleveland and there developed a highly successful private practice.

Charlie Emerson, a graduate of Massachusetts Institute of Technology, became associated with the city of Columbus and the city of Baltimore on their sewage treatment programs. Afterward, for 10 years, he was Chief Engineer of the Pennsylvania State Department of Health. For fourteen years he has been associated with Fuller & McClintock, Consulting Engineers, first in charge of their Philadelphia office and more recently (since Mr. Fuller's death) in the New York office.

Other associates with the Gascoigne organizations are W. L. Havens, H. H. Burger, F. C. Tolles and F. W. Jones. The New York offices, under Mr. Emerson, are located in the Woolworth Building; the Cleveland offices will remain, as before, in the centrally located Leader Building.

Wisconsin 4th Annual Short Course for Water Works Operators Highly Successful

With a registration of more than 50 students the Wisconsin 4th Annual Short Course for Water Works Operators, held under the direction of Professor L. H. Kessler of the University of Wisconsin and sponsored by the Wisconsin Department of Health, proved by far the best of the four schools yet held.

Eleven of the Water Works Superintendents, attending for their fourth year, constitute the "Senior Class"

4th Annual Water Operators Short School

which elected J. J. Angel, Water Supt. of Jefferson, Wis., as class president.

The Wisconsin Short Course covers a three and one-half day period of lectures from 8 a. m. to noon, followed by afternoon demonstrations and laboratory work with Round Table Discussions. Leading practical water works men assist with the lectures and discussion of operating problems. At the closing banquet, certificates of attendance are awarded by the Dean of the Engineering School of the University.

To H. W. Ruff, Instructor in Hydraulics and Sanitary Engineering, under Professor Kessler, goes much credit for the success of the Short Course.

No. 1 Senior and Prime Movers

J. J. Angell, Class Pres.; Prof. L. H. Kessler, Director; H. W. Ruff, His Assistant and "Wheel-Horse."

New Directors of A. W. W. A.

M. C. Smith (Virginia)

P. W. Frisk (North Carolina)

At the recent meetings of the Virginia and North Carolina Sections of the American Water Works Association, two new directors to the A. W. W. A. Board were elected.

Marsden C. Smith of Richmond, Va., was elected director to succeed E. F. Dugger of Newport News. The North Carolina Section named P. W. Frisk of Enka, N. C., to succeed M. F. Trice, of Raleigh.

Of the Virginia Section, A. L. Meisel, City Manager of Williamsburg, Va., was elected Chairman and North Carolina Section elected H. G. Baity as its new Chairman.

EDITORIAL

DEAR SANTA CLAUS:

We have tried hard to be good publishers all year and we want to ask of you a few things for 1937. We are not asking much for ourselves, but those things which we do ask for will benefit many of our best friends. This, in turn, will bring happiness to us and, thus, we will likewise be rewarded.

Dear Santa Claus, the first thing on our list to ask of you is a higher and growing realization on the part of John Q. Public of the true value of the water works utility to his community—to him personally, and to his loved ones. That he will do a little private investigating to learn how very dependent he, his family, and his very livelihood and well being, is on the water works manager and his high calibre conscientious staff, when it comes to the most essential and important commodity in the life of a community—a wholesome, safe and reliable supply of pure water. Let him realize that he depends upon a service which cannot permit the least of let-downs or even an *occasional* failure. We ask that Mr. John Q. Public take a glance at the salaries paid from his town's treasury to various city officials, and consider whether more of his water rent or tax dollar should not go to these men responsible for management and operation of the community's No. 1 utility. We urge you to ask him to compare water works salaries with those paid for the city's legal services and to other municipal officials carrying far less responsibility than the water works heads. We ask that he compare the remuneration of the water utility manager and his assistants with industrial managers in charge of plants representing the same approximate invested value, or those managers of industry having similar responsibilities. If he does this, we believe that Mr. John Q. Public will feel it his duty to bring organized effort into the city council to more equitably compensate the local water works personnel.

Dear Santa Claus, we ask for more city managers and politicians and public office holders who have sufficient grey matter, and sense of good judgment, to realize that the water works utility, above all other municipal enterprises cannot be used as a political football, less hazard to public health and property, or serious damage to the purse of the community caused through inexperience, is to be the result of such political tampering with the operating organization. Make the office holder realize, Santa Claus, that the water works must be no political "Christmas Tree" from which a rank imitation Santa Claus can pluck presents for the local butcher, baker and candlestick maker (this includes plumbers also), who come "well recommended" by some ward-heeler.

Dear Santa Claus, we ask your help in procuring job-security for efficient and faithful water works and sewerage operators, to foil the type of office holder who insists on believing that "to the victors go the spoils." We need your help in getting some adequate form of security for those men who must lose their jobs for no good reason other than the thin excuse of "a needed shake up." In this, Santa, some protection that has legal backing, such as operator licensing acts, for the present seems to us the most practical answer pending that time when the slower (if more desirable) process of "education" of public office holders may have become effective.

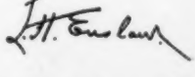
Dear Santa Claus, we ask for your influence with municipal officials in the matter of getting established pension systems for the benefit of water works and sewerage employees who unfortunately are automatically excluded from benefits under the recently passed Federal Social Security Acts, involving supporting pensions in old age or debility. We believe that, considering the years of meagre pay of the city employee, the municipal pension plan should be on a basis of higher employer contribution ratio than that of the Federal and State systems now applicable to industry.

Dear Santa Claus, send us more local editors who will take a higher interest in the water and sewage utilities and do the job, that can be so effectively done through the local press, of bringing the value of these public enterprises and their operating organizations to the deserved attention of the public. We also hope that you will help the managers of these utilities to become more publicity minded, not alone for their own good, but out of consideration for employees under them who will benefit therefrom.

Dear Santa Claus, give us more governors and state health commissioners who appreciate the full value of their state sanitary engineering divisions in their work involving assistance and supervisory services in water and sewage works operation, their functions in advancing the education, position and a higher local appreciation of the operator—frequently insuring his security against unjustified replacements with political change. Give us legislatures which see this value to the extent of voting more adequate and justified salaries to state sanitary engineers, salaries more commensurate with their accomplishments; and, also, building a more adequate personnel with which to carry on. Give us cleaner streams, Santa, by making of industrial waste treatment a technical matter, based on need rather than on argued expediency, involving commercial (profit-and-loss) banter. Help us to defeat postponement through political influence; help us to overcome the retarding effect—the lack of uniformity in pollution control from state to state.

And, dear Santa Claus, we think of much more to ask, but the final request we would place very high on the list. Please help A. W. W. A. to grow in strength and, thereby, in its influence toward advancement of the profession and *every* water works man who individually is in need of the help and support of a strong national association. Help its officers to put through the splendid program recently planned and to this end give A. W. W. A. the membership support it deserves and needs—especially the growth in corporate memberships and consequent support from municipalities, which have already benefited so much through the activities of A. W. W. A. and may benefit even more.

Maybe, Santa Claus, you can tell A. W. W. A. how it can operate a successful and economical old age retirement insurance plan for the benefit of its members. So far, the group insurance scheme has proved to lack practicability in that it cannot be made to work out equitably to all members.



EQUIPMENT NEWS

Split-Sleeves and Thoughts of Winter

The Dresser Manufacturing Co. announce that their experiences of 1936, taken with those of their customers, have led to extended preparations for the oncoming cold weather season in respect to a heavier stocking of, and readiness for rush shipment of, water main repair parts and emergency materials.

In 1936, the greatest demand ever put on the Dresser Company for rush shipments was for split-sleeves needed for use as here illustrated. The cast split-sleeve, pictured, has been especially designed for rapidity and ease of installation on a split, or broken water main—the necessity of turning off the pressure frequently being avoided. The job is done in quick time with but one tool—

Dresser Split Sleeve.

a wrench. The ditch does not have to be pumped dry, as with poured or caulked repair sleeves, and no frost-bitten or idle crew need be waiting around. The bolted-on sleeve can be considered a permanent repair even though used originally as an emergency installation. It, in fact, adds flexibility to the line repaired. For splits or fractures longer than 8 inches, two or more sleeves may be jointed. Split-Sleeves are also available for enclosing split bells.

The sleeve here pictured is a Dresser Style 57, and available for pipes 2 to 12 inches in diameter. The bell repair sleeve is Style 26, in sizes for pipe 3 to 24 inch diameter. For catalog describing Dresser Emergency Repair Equipment, address S. R. Dresser Manufacturing Co., Bradford, Pa.

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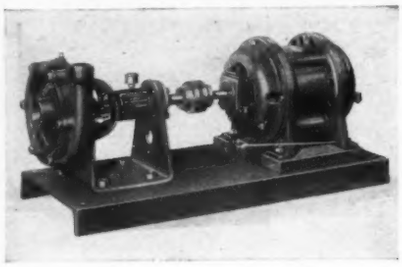
Small Centrifugals by Worthington

A small, low-cost centrifugal pump built by Worthington has recently been announced.

The utilization of a pressed steel frame, combined with quantity production, make possible a compact low cost unit with



Worthington New Small Centrifugal

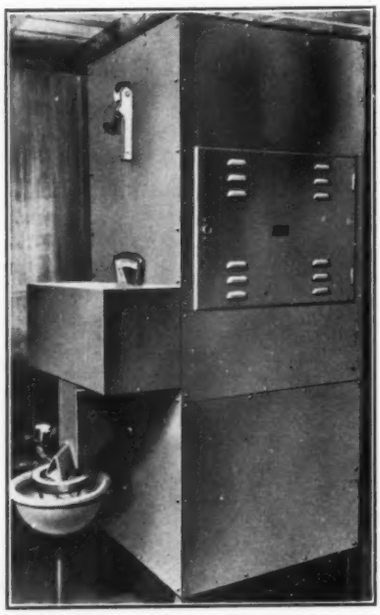
fewer wearing parts. The motor sizes range from 1/3 to 3 H.P., delivering from 10 to 130 gallons per minute against heads from 10 to 100 feet. The shaft is supported by two enclosed ball bearings and the suction head is easily removable for pump inspection. A choice of standard, all-iron, and all-bronze fittings is offered.

For descriptive bulletin (W-310-B5) showing cross-sectional views and details of construction address, Worthington Pump and Machinery Corporation, Harrison, N. J.

▼

New Chemical Feeder Features Batch Weighing

The Syntron Company of Pittsburgh, Pa., has developed a new dry chemical feeder for accurate control of dosage, by batch-weighing, which is subject to continuous or intermittent program operation. As frequently as each 15 seconds an exact weight (not volume) of the dry chemical is discharged into the continuous solution pot and thence to the fluid being treated.



Syntron Batch Weighing Feeder.

As on other Syntron feeders the high frequency quiet-magnetic vibration, applied to the hopper, precludes arching or other interference with continuity of dependable feeding of even the most sluggish flowing chemicals. The vibratory principle is also applied to the feed trough to insure streaming of the chemical to the weighing hopper until the balance trips the vibrator shut-off trigger at the exact weight "cut-off" set on the scale. An electric clock control creates contacts at 15 second intervals (longer if desired) which dumps the weighted batch into the constantly flowing solution pot.

The new Syntron Batch-Weight Feeder is constructed of stainless steel wherever contact exists between its parts and the chemical. It is enclosed in a dust tight cabinet with the scale dial exposed and plainly visible.

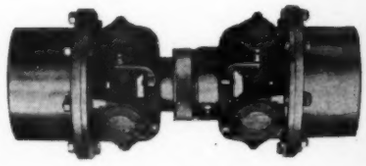
The smaller model feeds from ⅛ ounce to 1 pound at each batch dump, and this at 15-30-45-60 second intervals as desired. The manufacturer claims an accuracy within 0.5 per cent plus or minus —on an *exact weight* basis.

For illustrated literature listing models, capacities, prices, address Syntron Company, 400 N. Lexington Ave., Pittsburgh, Pa.

▼

Novel Pump Drive Unit

A novel and highly interesting pump-drive has been recently developed by the H. S. Watson Company of San Francisco. This new adjunct to pump operation is known as the Watson-Spicer Drive —the heart of this very modern design being its needle-bearings. The result is an almost unbelievable compensation for misalignments of all sorts. The manu-

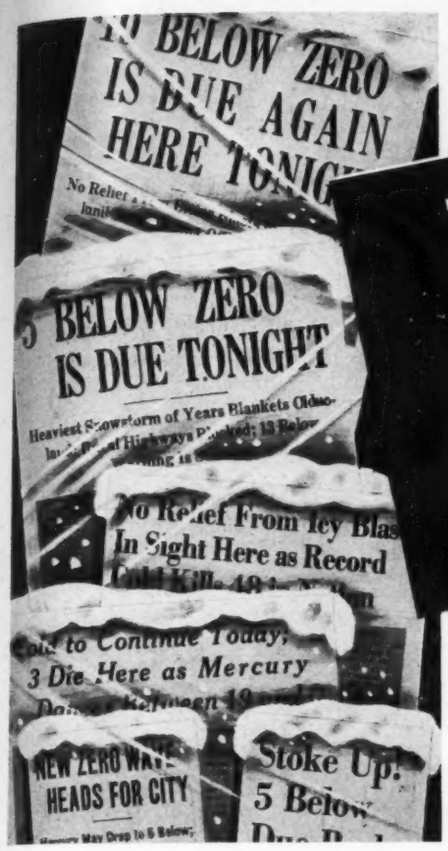


Watson-Spicer Drive

facturer claims, with considerable emphasis, that angularity of drive shaft of as much as 20 degrees will be corrected without heating or noise.

The Watson-Spicer Drive for water and sewage pumps can be used in connection with vertical as well as horizontal installations. For the vertical, long sections in required number are employed. For the horizontal, single units are used in any length, from inches to feet. These units are available for drives up to 250 h.p. input.

For an effectively descriptive illustrated folder on this novel drive, ask for "Watson-Spicer Drives." Address: H. S. Watson Company, 525 Fourth St., San Francisco, Calif.



LAST WINTER WAS A

. . . But it Proved that DRESSER SPLIT SLEEVES are the Quickest, Easiest, Most Practical Method for Making Pipe-Break Repairs!

TAKE A LESSON from last winter. Be prepared for cold-weather pipe-breaks. Then you won't have to worry about continued tie-ups, delays, and expense.

Here's how Dresser Split Sleeves are making life more pleasant for waterworks superintendents and for everyone else in water departments:

To fix a pipe-break (or split or hole), all you have to do is sling the two halves of a Dresser Split Sleeve into position around the break, draw up the bolts and get your service fully restored in the least possible time!

Send today for Folder No. 57, and ask for prices on specific pipe sizes in your system.

BELOW—*Cutaway view of a Style 57 Split Sleeve. Every one is air- and hydrostatic-tested before shipment. Two or more can be joined in multiple installations, to cover breaks longer than 8".*

Get these High-Points about Dresser Split Sleeves:

1. You don't have to shut down the line completely—often not at all.
2. You don't have to drain the line and dry the ditch.
3. You can make a permanent repair, often in less time than it takes to get ready the old way.
4. Your own men can easily install . . a wrench is the only tool needed.
5. High-tensile-strength materials mean less weight to handle—easier to place in any weather or ditch conditions.
6. Cast bolts are used throughout.
7. Patented, grooved side-pack holds gasket in position, even when installed under high pressure.
8. A completely engineered, time-tested product—thousands of cases to prove its value.

DRESSER SPLIT SLEEVES

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In Canada **Dresser Mfg. Company, Ltd., 60 Front St., W., Toronto, Ont.**

When TEMPERATURE and pH are LOW

Such common winter difficulties as the treatment at low temperatures of soft, highly colored waters of low alkalinities do not bother the operator who uses Ferrisul as a coagulant. Even in extremely cold waters, Ferrisul gives a quick-forming, rapid-settling floc over the entire pH range from 3.5 up. Write for Ferrisul booklet, or consult us about your specific problems. MERRIMAC CHEMICAL CO., Everett Station, Boston, Mass. (*A subsidiary of* MONSANTO CHEMICAL CO.)

Ferrisul
FOR WATER AND SEWAGE TREATMENT

CATALOGS AND LITERATURE RECEIVED:

[*Any of the publications reviewed in this section can be secured from or through Water Works and Sewerage, if such be desirable.*]

"P.F.T. Floating Covers"—In 40 attractively illustrated pages, Pacific Flush Tank Company, pioneering manufacturers of sewerage equipment, presents a complete story of Downe's Floating Covers for sludge digesters. It discusses the principles and inherent advantages of floating covers for keeping scum submerged and more fluid and readily digestible thereby; of precluding possible hazardous air entry to the digester; of making bookkeeping in sludge accounting (into and out of digesters) and supernatant liquor volume more exact and simple; the value of insured constant gas pressure, etc. The economy of sludge digestion with gas utilization is thoroughly covered, with confirming findings. Also, is the value of stage digestion and the place of the floating cover in this method; likewise, the value of "stratified" digestion where single units must be relied upon. Many practical considerations and design features are set forth in discussing the arrangement of sludge digestors, and these are made the clearer with line drawings. The detailed design of digestors and the improved (1937) P. F. T. covers and tanks are illustrated as an aid to designing engineers. Operating procedures and precautionary measures are suggested and installations from the smallest at Beltsville, Md. (20 ft. diam.) to the largest at Cleveland (12 hexagonal units, each 95 ft. diam.) are pictured.

For a copy of "P. F. T. Floating Covers" ask for Catalog 132. Address Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago, Ill.

"Testing Water Meters"—A colorful and worth having publication, neatly spiral bound, tells the *"Why and How"* of modern meter-test practices. It comes from Ford Meter Box Co., and contains, under one cover, reprinted articles or excerpts selected from the literature representing those most practical and useful to water works men concerned with meters. The brochure also contains several diagrams and charts of genuine value in meter maintenance and in facilitating efficiency in meter shop practices. Attractively gotten together and illustrated (as is the rule with Ford productions) every water works manager and meter-department head will be well repaid for requesting a copy of "Testing Water Meters," which is essentially a hand-book. Address Ford Meter Box Co., Wabash, Indiana.

"Hypo-Chlorination in Sewage Treatment"—From Proportioneers, Inc. (subsidiary of Builders Iron Foundry) has been received a discussion of sewage chlorination with special reference to the question of liquid chlorine vs. modern high test hypochlorites for the purpose. Revolving on the matter of cost of feeding equipment, plus cost of the sterilizing agent, the discussion reaches some definite conclusions as to what size installations warrant adoption of "Chlor-O-Feeder" type of hypochlorite solution-feed equipment, and what size warrant liquid chlorine equipment. And, equally important, under what conditions, such as continuous vs. seasonal operations. Accompanying sketches illustrate manually controlled and automatic installations of

sewage "Hypo-Chlorinators" and "Ferr-O-Feeders" for coagulation of sewage or sludges. This evaluating discussion, interesting to engineers and sewerage authorities, may be had by addressing Proportioneers, Inc., No. 9 Godding St., Providence, R. I.

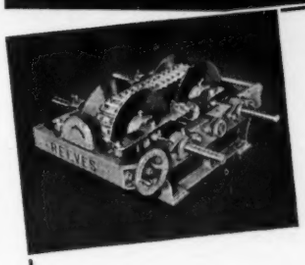
"The Answer to Water Leak Problems"—Is the title of a well illustrated pocket size booklet received from the Water Leak Detector Co. of Columbus, Ohio. Without benefit of illustration the novel and interesting "Universal Leak Detector" was described in the "Equipment News" section of our last issue. It involves selective radio tuning of high frequency vibrations, caused by high-velocity leaking water, to determine the approximate size as well as exact location of hidden leaks. The new booklet describes this ingenious device in principle, and pictures the several models and the methods of its use on the street. With it, a loop-aerial attachment is supplied for converting the machine to radio pipe-locator whenever needed. For a copy of "The Answer to Leak Problems", address The Water Leak Detector Co., 155 N. Third St., Columbus, Ohio.

"Diesel Engines"—A new bulletin from Cooper-Bessemer Corporation, illustrates and describes "America's Most Beautiful Diesel Engine," the 1937 Model Type G-N, to which the appellation now applies in appearance as well as performance. Especially featured, is the new atmospheric-relief constant-pressure system of fuel-oil injection. The reputation of Cooper-Bessemer engines needs no great elucidation on the several already time tested features of these engines, which are set forth. In 3 to 8 cylinders, these units are available for output of 150 h.p. and upwards. Increasing adoption of Diesel engine drives in municipal and private plants testifies to their value and dependability. The new "G.N." Diesel, sold on merits rather than initial cost, should appeal to those studying Bulletin 308. For a copy address Cooper-Bessemer Corp., Mount Vernon, Ohio, or Grove City, Pa.

"Acid Proof Cements"—From Pennsylvania Salt Company has been received their first booklet describing the properties and applications of "Penchlor" Acid Proof Cement which is a power base mixed at point of application with silicate of soda solution. It is guaranteed resistant to hot or cold acids of all strengths. Its chief use is as a mortar for laying up acid proof brick for solution tanks. Also, it has potentialities as a surfacing slurry for concrete or brick sewers and manholes or metal parts subjected to so-called sewer gas attack. For this little booklet, "Acid Proof Cements," address Pennsylvania Salt Manufacturing Company, Widener Building, Philadelphia, Pa.

"Coleman pH Electrometer"—The "Waco Catalyst," published by Wilkins-Anderson Co. (the Chicago house of laboratory supplies and chemicals), amongst a variety of laboratory equipment, presents features of and pictures the improved 1937 Coleman pH Electrometer. It reveals in direct readings any pH from 0 to 13, is reasonably priced, is economical to maintain and operate, has smaller *sealed* glass and "Ball" calomel electrodes requiring no preparation by user. Result: a longer life for the self-contained dry cell batteries. Boasting 400 units in the hands of satisfied users, Wilkins-Anderson Co. offer 5 day trials —keep it or return it. Laboratory men can obtain regular mailings of "The Catalyst" by writing "WACO." The address is "three aces" (111) North Canal St. in Chicago, Ill.

Modern, Time-Tested SPEED CONTROL For Sewage Processes



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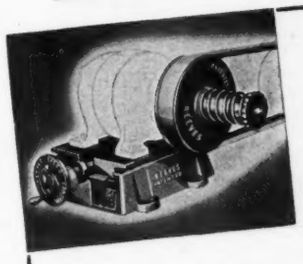
Provides infinite speed adjustability over wide range on any machine it regulates. Accurate, positive at all speeds. Modern open and enclosed designs, vertical and horizontal. 15 sizes—fractional to 100 h. p. Speed variations 2:1 to 16:1 inclusive.



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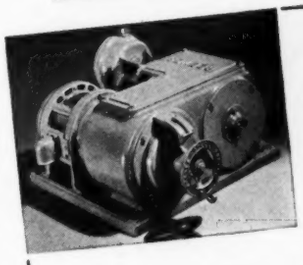
Simplified development of Transmission. Mounts on standard shaft of any constant speed motor. Forms direct drive to machine. Sliding motor base is moved forward or back for speed changes. Seven sizes—fractional to 7½ h. p.; 3:1 range of variation.



REEVES VARI-SPEED MOTODRIVE

Combines in one compact, self-contained enclosure, constant speed motor, REEVES speed varying mechanism and reduction gears (where required). Available in space-saving horizontal and vertical types—¼ to 10 h. p. Speed variations 2:1 to 6:1 inclusive.

Wherever variable factors are encountered in sewage treatment processes—variations in flow rate, consistency, rate of feed, etc.—equipment which is provided with REEVES Speed Control has the complete speed adjustability to compensate accurately for all these variables. As a result, REEVES units are being applied to pumps, screens, filters, chemical feeders, clarifiers, spray dryers, incinerators, etc.—and vital operating advantages are always secured. Send for free copy of 112-page Speed Control Handbook S-36. REEVES PULLEY COMPANY, Columbus, Indiana.

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PRECISION MACHINE WORK

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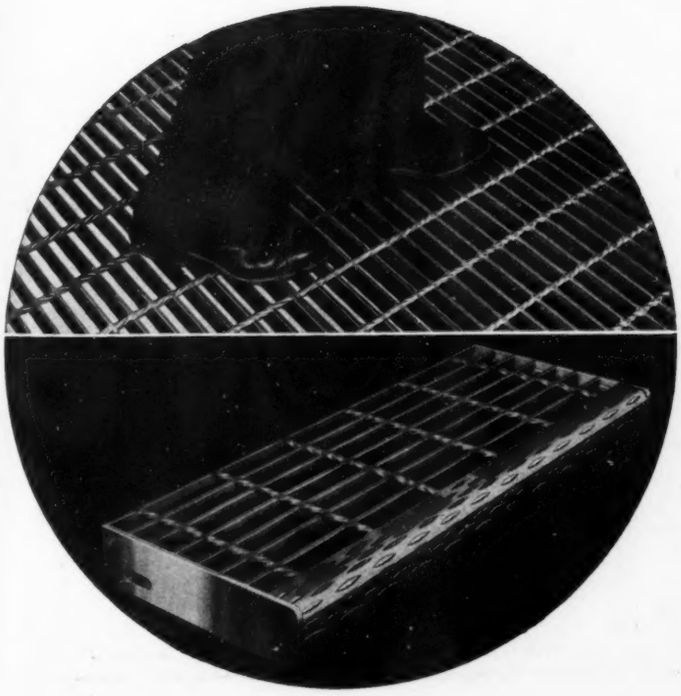

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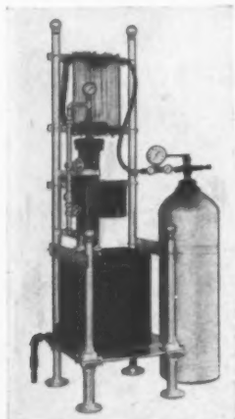

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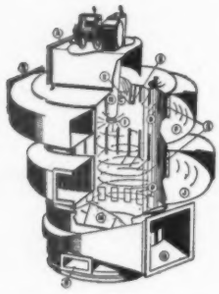

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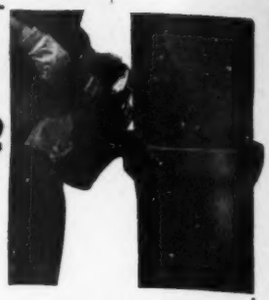

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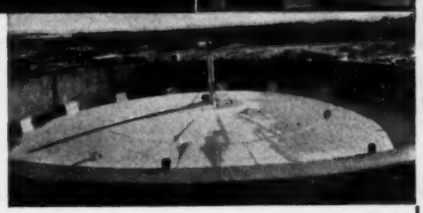

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December

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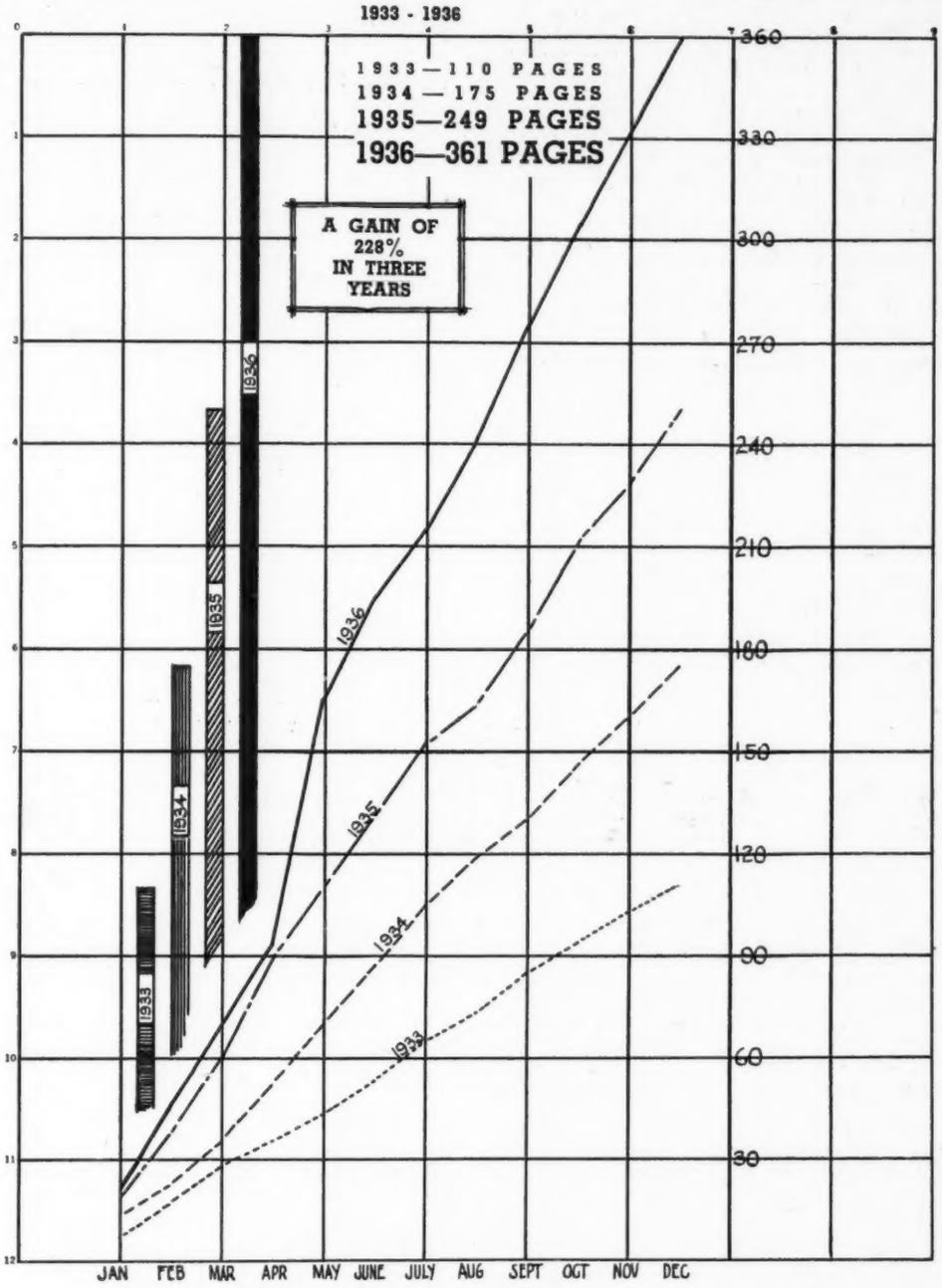

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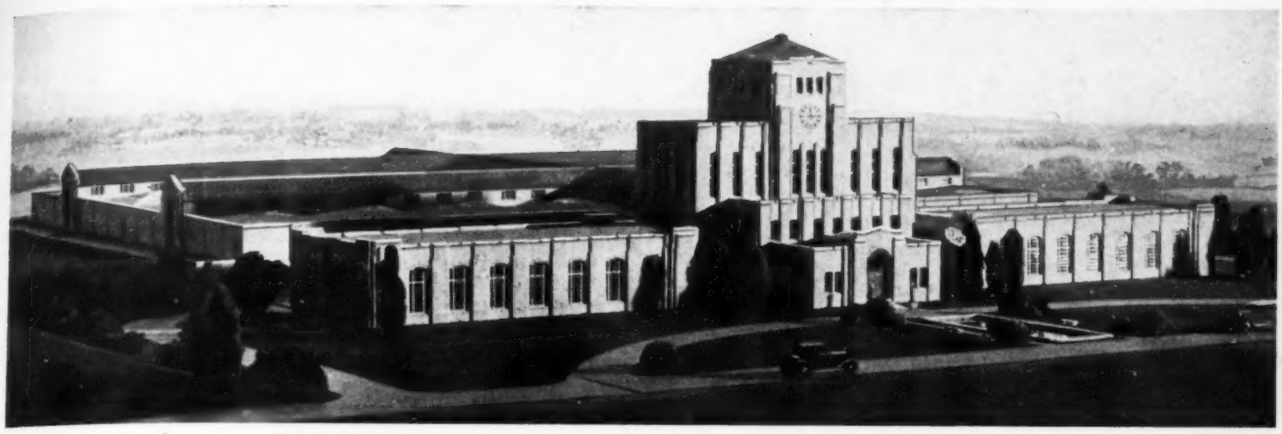
*Advertisers with * were represented in the May, 1936, Convention and Data Edition with catalog specification copy. Please refer to that issue for additional information on any of their products.

A 200 M.G.D. INSTALLATION of DORRCO FLOCCULATORS



Model of Milwaukee's new water purification plant. Alvord, Burdick & Howson, Cons. Engrs.

Some Large Dorrco Flocculator Projects

Milwaukee, Wisc. — 200 M.G.D.
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Cincinnati, Ohio — 200 M.G.D.
Burns & McDonnell, Cons. Engr.
Denver, Colo. — 50 M.G.D.
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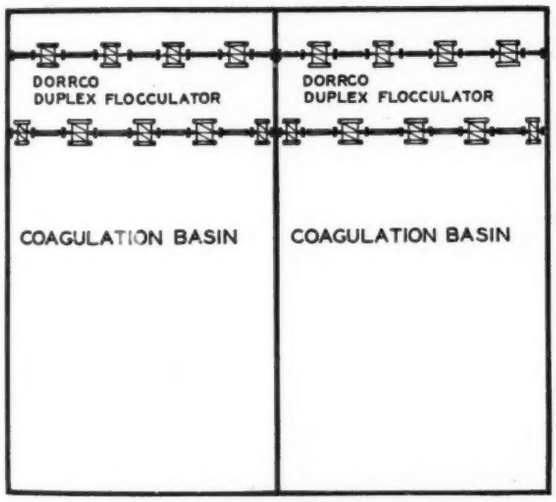
Louisville, Ky. — 200 M.G.D.
John H. Chambers, Ch. Engr.; W. J. Lovejoy, Supt.
Covington, Ky. — 19 M.G.D.
J. S. Watkins, Cons. Engr.
Muskegon, Mich. — 7 M.G.D.
Townsend & Quinlan, Cons. Engr.
Michigan City, Ind. — 5 M.G.D.
Greeley & Hansen, Cons. Engr.



Two of the four Dorrco Flocculator units at Milwaukee. Other two arranged identically.

Milwaukee's new water treatment plant has one of the largest Dorrco Flocculator installations in existence—4 duplex units, each consisting of 2 rows of 14 ft. dia. paddles 148 ft. long. 200 M.G.D. of raw water will be treated with alum, flocculated, settled and filtered.

Dorrco Flocculator installations comprise an impressive list of old plants as well as new ones, because they are easily fitted into existing settling basins. The Dorrco Flocculator is the only unit in the sanitary engineering field that actually pays for itself through reducing chemical consumption from 10-40 per cent.

Dorrco Flocculator Savings at Louisville, Ky.

		per yr.
● Less Chemicals	—20-30%	$4,000
● Longer Filter Runs	—40%	
● Less Filter Wash Water	—30%	$1,000

This figures out to a total indicated saving of $5,000 per year, equivalent to a 40 per cent return on the investment.

DORRCO

Write for our bulletin on "Flocculation and Mixing"

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SOUTH AFRICA: Edward L. Bateman Pty. Ltd., Johannesburg
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ARGENTINA: Luis Fiore, Buenos Aires
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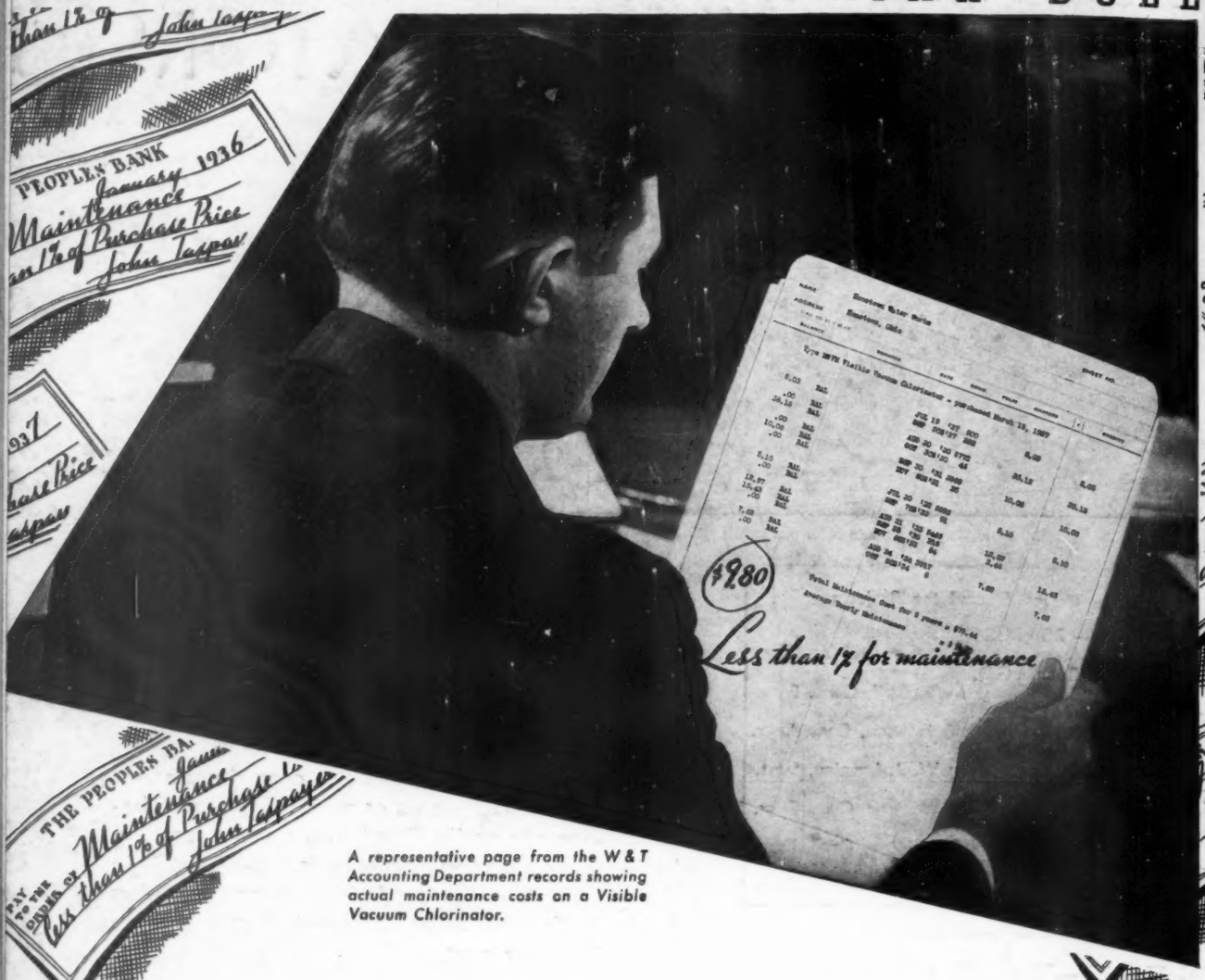
SAVING TOMORROW'S TAX DOLLAR



A representative page from the W & T Accounting Department records showing actual maintenance costs on a Visible Vacuum Chlorinator.

THE CHLORINATION DOLLAR MUST BUY ..MAINTENANCE ECONOMY

"HOW MUCH does it cost for upkeep?" is tomorrow's question. With a W&T Visible Vacuum Chlorinator the answer is ready — "Annual maintenance less than ONE PERCENT of the purchase price."

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Ease your mind on chlorination by selecting W&T Visible Vacuum Chlorinators for dependable, accurate, trouble-free service, at minimum maintenance expense.

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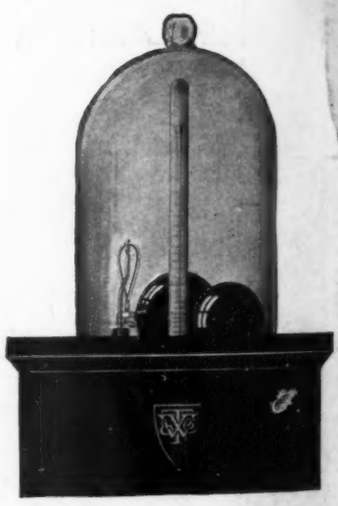

Technical publications 38, 157 and 158 describe W & T Visible Vacuum Chlorinators. Ask for your copies.

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